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An updated review on *Alstonia scholaris*: A delightful therapeutic plant

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Abstract
Background: The term "therapeutic plant" generally refers to plants that have medicinal properties and are used for various health benefits. Many cultures throughout history have recognized the healing properties of certain plants and have incorporated them into traditional medicine systems. The background of therapeutic plants is rich and diverse, encompassing a wide range of species and traditions.
Plant profile with therapeutic effects: *Alstonia scholaris*, commonly known as the "Indian Devil Tree" or "Saptaparni," is a tropical evergreen tree native to Southeast Asia, South Asia, and Australia. It belonging to the family Apocynaceae. This tree has several traditional uses and is known for its medicinal properties in various traditional medicine systems. Here is a profile of *Alstonia scholaris*, including some of its therapeutic effects: It is a tall, straight tree that can reach heights of up to 40 meters with smooth, glossy, light gray bark and elliptical leaves which arranged in whorls. The tree produces small, white, fragrant flowers in clusters. The fruit is a long, narrow follicle containing numerous seeds with a tuft of silky hairs. The bark, root, leaves contain various secondary metabolites which contribute to its medicinal. Traditional medicinal uses of this plant to treat respiratory condition and also having antimalarial, anti-inflammatory, anti-oxidant, anti-microbial effects. In traditional cultures, sometimes this plant associated with religious or cultural practices also valued for its timber, which is used in construction and woodworking.
Discussion: Many scientific studies are done to identify the medicinal properties of many plants for the development of society, this plant is also part of the research. This plant had many traditional uses and this is the only reason to conduct various researches on this plant.

Keywords: Therapeutic properties, botanical features, phytoconstituents, traditional cultures, pharmacological uses

Introduction
Phytochemistry is a branch of science which describes the nature of herbs as well as it's medicinal properties. Several plant species endowed with these phytochemicals have been documented to serve as many medicinal herbs. Although several conventional chemical-based drugs are quite popular, herbal and plant based medicinal drugs, also known as herbal medicine, traditional medicine or complementary medicine are quite popular in developing countries like India. Plants have been a major source of therapeutic agents since time immemorial and traditional herbal systems of medicine, like ayurveda, resulted in the revival of ancient traditions of medicine. Therefore, indispensable scientific authentication of these medicinal values of plants will pave the way for future herbal drugs. Many plants, whole and parts, and their products have been used in folklore medicine since ancient time for curing human ailments. It has a long history of traditional medicinal use, and several phytochemical compounds found in various parts of the tree are associated with its potential medicinal properties. Phytochemicals in *Alstonia scholaris* contribute to its traditional uses for a range of health issues, including fever, dysentery, cough, and as a remedy of snakebites. The phytochemical composition varies according to the age of the plant, environmental condition, geographical location of the plant [1].
Alstonia scholaris, commonly known as "Devil's tree" or "Saptaparni", is a native to tropical Asia, southern Bangladesh, India, Nepal, China, Sri Lanka, Australia, Pakistan. It is common ornamental plant. It is a toxic plant, but it used traditionally in several treatments [2].

It is a glabrous tree and grows up to 40m tall. The upper side of the leaves are glossy, and the lower side is greyish, petioles are 1–3 cm; the leathery leaves are narrowly obovate, base cuneate, apex usually rounded and up to 23 cm long by up to 8 cm in width. The ovaries are distinct and pubescent. The follicles are distinct and linear. Seeds are oblong, with ciliated margins, and ends with tufts of hairs 1.5–2 cm. Its mature bark is greyish and its young branches are copiously marked with lenticels. The bark is odorless and contains the taste of bitterness. Flowers bloom in October [3].

Table 1: Taxonomical classification

Kingdom	Plantae
Subkingdom	Tracheobionta, vascular plants
Division	Magnoliophyta, flowering plants
Class	Magnoliopsida, Dicotyledon
Subclass	Asteridae
Clade	Tracheophytes, Angiosperms, Eudicots
Order	Gentianales
Family	Apocynaceae
Phylum	Tracheophytes
Genus	Alstonia

- **Common names of *alstonia scholari:*** Blackboard tree, Scholar tree, Milkwood, Devil's tree, Indian pulai, White cheesewood, Dita bark, Bitter bark, Saptaparna, Saptachada, Chatraparna [4].
- **Parts Used:** Stem, bark, root, leaves.

Pharmacognostical Study

Pharmacognostical screening of *Alstonia scholaris* has given more information about the physical, chemical, biological properties and specially for authentication of this plant. Pharmacognostical screening ensures that the herbal medicine or botanical product contains the expected phytochemicals and free from contaminants, thereby ensuring its safety and efficacy for traditional or modern medicinal use.

After extracted with hexane, benzene, isopropanol, ethyl acetate, methanol, water [1], ethanolic HCL [5-10], petroleum ether [11-13], petroleum ether, chloroform, methanol [14] the above extracts were collected. Then methanolic extract [15] basified with EtOAc and partitioned in aqueous phase and organic phase, it redissolved in MeOH and subjected to column chromatography by using mobile phase $CHCL_3$-Me_2CO to collect five fractions (I-V) [5]. Also, chemical fingerprinting performed using a Shiseido Capcell-pak C18 column comprised with methanol and water as mobile phase where UV data collected from 200 to 400 nm and flow rate was 0.8 ml/min with the volume of injection was 7µl [8].

Four chemical components were identified as the major medicinal agents, including-scholaricine [RT] = 22.057 min, 19-epischolarine [RT] = 23.667 min, vallesamine [RT] = 44.915 min, picrinine [RT] = 74.29 min, and the contents were 1.13%, 5.26%, 13.91%, 17.39%, respectively [10], also it gave following fractions: n-alkanes (C23-C33), esters (C40-C52), alkanols (C24-C30), triterpenes, α-amyrin, lupeol, and sterols (Cholesterol, Campesterol, Stigmasterol, β-sitosterol and stigmast-7 enol) [11], gallic acid, catechin, epicatechin, ellagic acid, kaempferol [15].

Phytochemical Study

Phytochemical screening performed for identification that which secondary metabolites are present inside the plant material. The presence of the secondary compounds helps to perform further pharmacological study of the plant. The following table (Table3) showed which secondary compound is present inside the plant.

Table 2: Phytochemical Screening [1, 5, 14, 16-22]

Compound	H	B	I.P	M	W	E	P. E	C
Alkaloids	++++	++++	++++	++++	++++	++++	--	+++
Carbohydrates	--	--	+++	+++	--	++	--	--
Amino acids	--	--	--	--	++	--	--	--
Fixed oils & fats	+++	++	--	+	--	+++	--	--
Phenolic compounds	+++	++++	++	++++	--	--	--	--
Terpenoids	++++	--	+++	++++	++++	+++	--	--
Cardiac glycosides	--	+++	--	--	--	--	--	--
Steroids	++++	++++	++++	++	+++	++	++	--
Saponins	--	--	++++	++++	++++	--	--	--
Tannins	--	++++	++++	++++	--	++++	--	--
Flavonoids	++	++++	+++	++	+++	++	--	--

*Weak (+), moderate (++) strong (+++) very strong (++++), absent (--)

[H-Hexane; B-Benzene; I.P-Iso Propanol; M-Methanol; W-Water; E-Ethanol; P.E-Petroleum Ether; C-Chloroform]

Pharmacological Study

Antibacterial study

Chandra Shekhar Misra et al. performed a study to identify the antibacterial activity of plant material, and the following results showed after performing the tests [1].

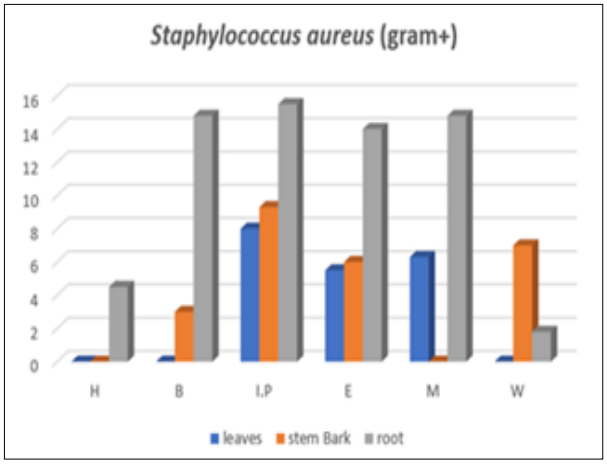


Fig 1: Standard-DMSO-0; C-25

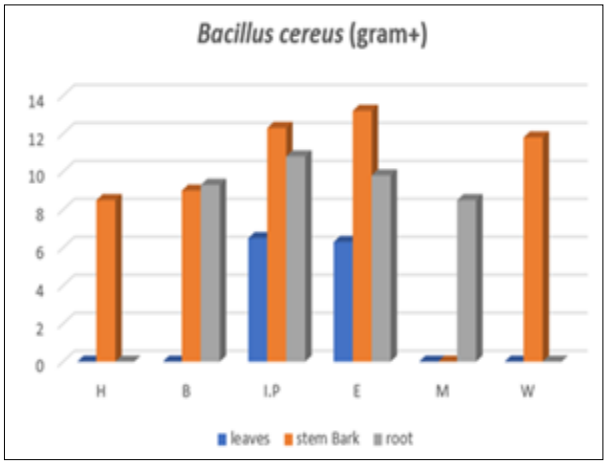


Fig 2: Standard-DMSO-0; C-18

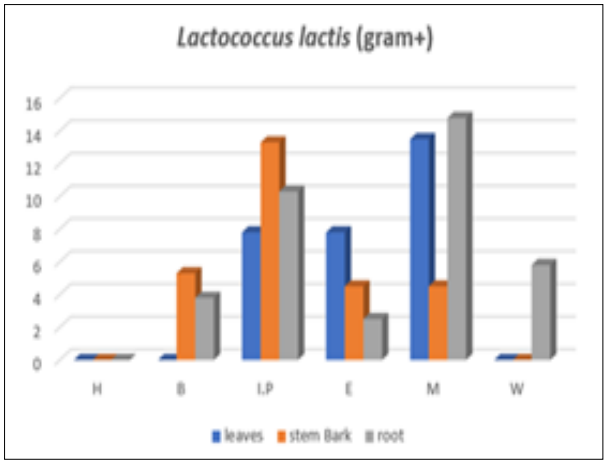


Fig 3: Standard-DMSO-0; C-22

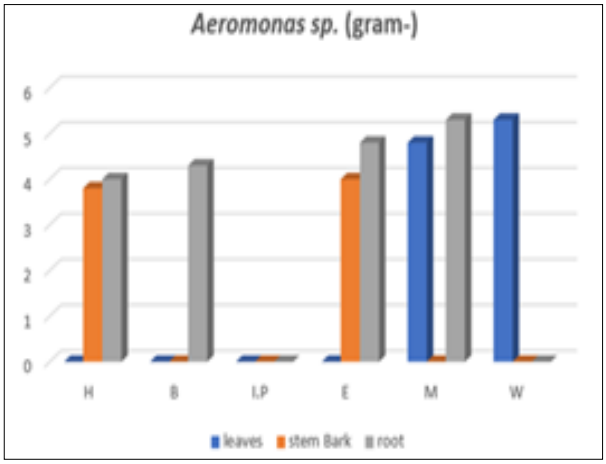


Fig 4: Standard-DMSO-0; C-21

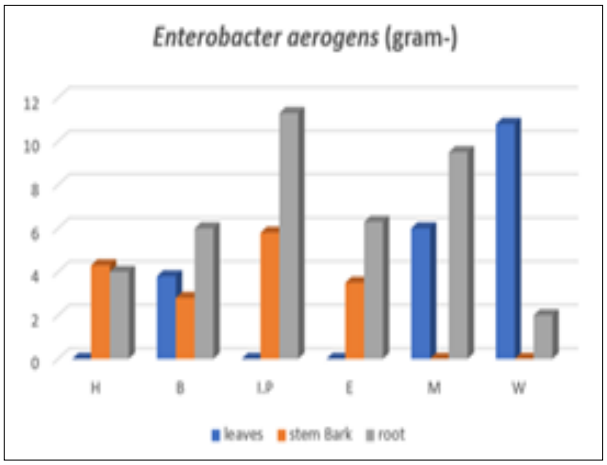


Fig 5: Standard-DMSO-0; C-24

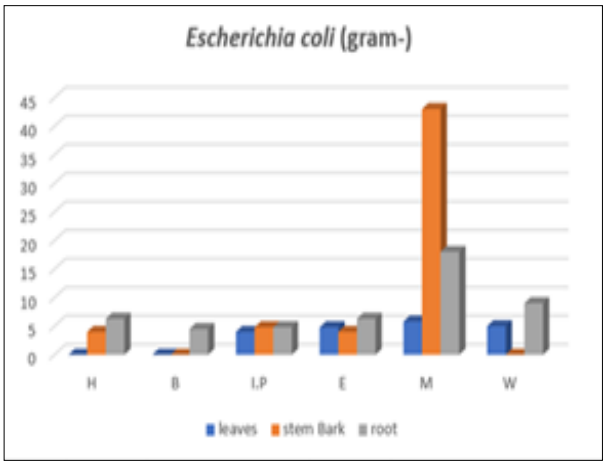


Fig 6: Standard-DMSO-0; C-23

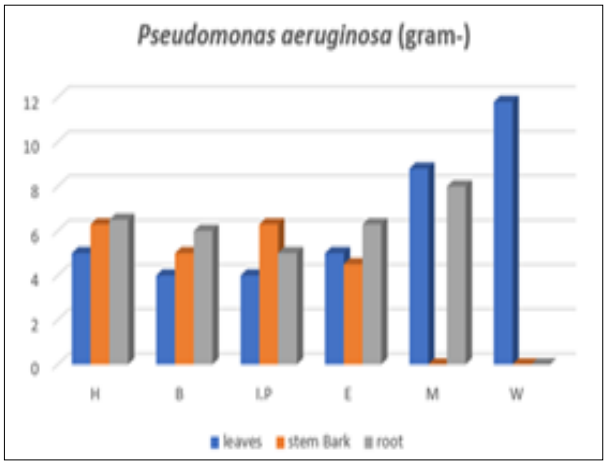


Fig 7: Standard-DMSO-0; C-22

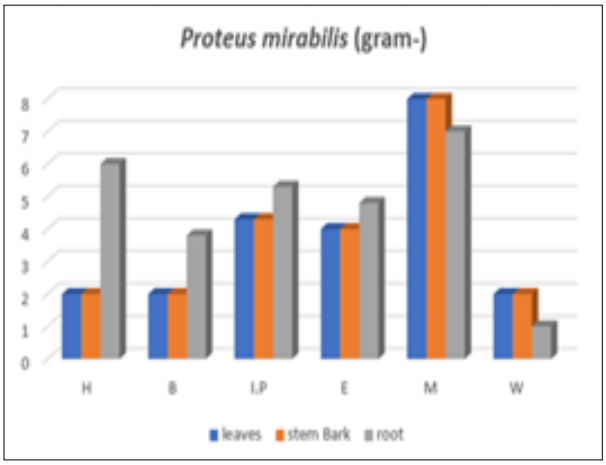


Fig 8: Standard-DMSO-0; C-19

[H-Hexane extract, B-Benzene extract, I.P-ISO Propanol extract; E-Ethanol extract, M-Methanol extract, W-Water extract, DMSO-Di Methyl Sulphoxide, C-Chloramphenicol]

- In Fig-1 Iso Propanol extract of root showed major antibacterial (gram +) effect when compared with DMSO-0 and Chloramphenicol-25 concentration.
- In Fig-2 Ethanolic extract of stem bark showed major antibacterial (gram +) effect when compared with DMSO-0 and Chloramphenicol-18 concentration.
- In Fig-3 Methanolic extract of root showed major antibacterial (gram +) effect when compared with DMSO-0 and Chloramphenicol-22 concentration.
- In Fig-4 Methanolic extract of root and aqueous extract of leaves showed major antibacterial (gram-) effect when compared with DMSO-0 and Chloramphenicol-21 concentration.
- In Fig-5 ISO Propanol extract of root showed major antibacterial (gram-) effect when compared with DMSO-0 and Chloramphenicol-24 concentration.
- In Fig-6 Methanolic extract of stem bark showed major antibacterial (gram-) effect when compared with DMSO-0 and Chloramphenicol-23 concentration.
- In Fig-7 Aqueous extract of leaves showed major

antibacterial (gram-) effect when compared with DMSO-0 and Chloramphenicol-22 concentration.

- In Fig-8 Methanolic extract of stem bark and leaves showed major antibacterial (gram-) effect when compared with DMSO-0 and Chloramphenicol-19 concentration.
- *Anuradha Varshney and MM Goyal* performed antibacterial study for gram (+) and gram (-) bacteria of different extracts and showed the following results (Table 4, 5) [11].

Table 4: Antibacterial activity against gram positive bacteria

Compound	*Shigella Auerus*		*Staphylococcus Albus*		*Bacillus Subtilis*	
	1mg/ml	0.5mg/ml	1mg/ml	0.5mg/ml	1mg/ml	0.5mg/ml
Alkanes	+	+	+	-	+	+
Esters	-	-	-	-	-	-
Alkanols	-	-	-	+	-	-
α-amyrin	+	+	+	+	+	+
Lupeol	+	-	+	+	+	+
Sterol	+	+	+	+	-	-
α-amyrin acetate	+	+	+	+	+	-
Lupeol acetate	+	+	+	-	+	-
Steryl acetate	+	+	+	+	+	-
Sito steryl acetate	+	+	+	+	-	-
Stigma steryl acetate	+	+	+	+	-	-

Table 5: Antibacterial activity against gram negative bacteria

Compound	*Escherichia coli*		*Klebsiella*		*Shigella dysentriae*		*Proteus vulgaris*		*Pseudomonas pyocyanea*	
	1mg/ml	0.5 mg/ml	1mg/ml	0.5 mg/ml	1mg/ml	0.5 mg/ml	1mg/ml	0.5 mg/ml	1mg/ml	0.5 mg/ml
Alkanes	+	+	+	+	+	+	+	+	+	+
Alkanols	-	-	-	-	-	-	-	-	-	-
Sterol	+	+	+	+	+	-	+	+	-	-
Steryl acetate	+	+	+	-	-	-	+	+	+	-
Sitosteryl acetate	+	+	-	-	+	-	+	+	+	+
Stigmasteryl acetate	+	+	+	-	+	-	+	+	+	+
Esters	-	-	-	-	-	-	-	-	-	-
α-amyrin	+	+	+	+	+	+	+	+	+	+
Lupeol	+	+	-	+	-	+	+	+	+	+
α-amyrinacetate	+	-	-	-	-	-	+	+	+	+
Lupeol acetate	+	-	-	-	-	-	+	+	+	+

Anti-inflammatory effects

- *Soo-Jin Lee et al.* performed a study to identify the anti-inflammatory effect of *Alstonia scholaris* extract on all-trans retinoic acid induced inflammation in *In vitro* study that-HaCaT cells were treated with ATRA and made cassoside and hydrocortisone used as control agents. ASE cells were treated with interleukin-8 and monocyte chemo attractant protein-1. MCP-1 levels were 928.8±64.0 pg/mL (at 100 ppm) and 1074.0±82.2 pg/mL (at 500 ppm). Inhibition was less than the result which seen in madecassoside-treated cells, in which the MCP-1 levels decreased by 1221.6±100.8 pg/mL (at 100 ppm) and 1271.0±69.0 pg/mL (at 500 ppm), but it was comparable to that seen in hydrocortisone-treated cells (1027.6±48.5 pg/mL at 1 ppm).

ASE decreased IL-8 expression by 619.3±44.4 pg/mL at 100 ppm and 417.1±29.0 pg/mL at 500 ppm, so these were compared to the results obtained from madecassoside, which decreased IL-8 expression by 584.6±70.6 pg/mL at 100 ppm and 589.8±31.0 pg/mL at 500 ppm (Table6) [8].

Table 6: Anti-inflammatory effect of *Alstonia scholaris* extract in all-trans retinoic acid treated HaCaT human keratinocytes

Test substance	MCP-1		IL-8	
	Pg/ml	% of Inhibition	Pg/ml	% of Inhibition
ASE 500ppm + ATRA 1 µm	928.8±64.0	96.6	417.1±29.0	83.9
ASE 100 ppm + ATRA 1 µm	1074.0±82.2	82.1	619.3±44.4	26.3
Madecassoside 500 ppm + ATRA 1 µm	1271.0±69.0	62.5	589.8±31.0	34.7
Madecassoside 100 ppm + ATRA 1 µm	1221.6±100.8	67.4	584.6±70.6	36.2
Hydrocortisone 1 ppm + ATRA 1 µm	1027.6±48.5	86.8	407.7±20.8	86.6
ATRA 1 µm	1898.2±72.0	0	711.8±27.0	0
Control	894.7±141.0	100.0	360.4±28.8	100.0

- After performing inhibitory Effect of ASE on Matrix metalloproteinase-1 Production by Irradiated Human Dermal Fibroblasts result showed that, treatment with 10 ppm ASE + 1 µM ATRA significantly attenuated MMP-1 expression by 335.6±50.5 ng/mL and 389.3±28.1 ng/mL, respectively. These values were much lower than the inhibitions observed in cells treated with ATRA or ROL alone (557.4±9.7 ng/mL for 1 µM ATRA; 708.9±30.8 ng/mL for 1 µM ROL) (Table7) [8].

Table 7: Effect of ASE associated with UV-induced MMP-1 expression on human primary fibroblasts

Test substance	mg/ml	% of inhibition
ATRA 1 µm + UVB 40 ml	557.4±9.7	74.3
ASE 0.1 ppm + ATRA 1 µm + UVB 40 ml	424.6±6.9	105.0
ASE 10 ppm + ATRA 1 µm + UVB 40 ml	379.7±18.3	115.3
	335.6±50.5	125.5
ROL 1 µm + UVB 40 ml	708.9±30.8	39.2
ASE 0.1 ppm + ROL 1 µm + UVB 40 ml	522.5±13.3	82.3
ASE 1 ppm + ROL 1 µm + UVB 40 ml	439.4±38.4	101.5
ASE 10 ppm + ROL 1 µm + UVB 40 ml	389.3±28.1	113.1
UVB 40 ml	878.5±30.2	0.0
Control	446.0±28.5	100.0

- Then after identified the effect of ASE on Capsaicin-Induced Calcitonin gene-related peptide Production, to investigate the effect of ASE on neurogenic inflammation. In the experiment CGRP produced from differentiated neuronal cells treated with 300nM of capsaicin with/without ASE. CGRP production was increased about 150 to 250% with capsaicin treatment, but this was inhibited by cotreatment with ASE (Table8) [8].

Table 8: Evaluation of capsaicin-induced CGRP expression in the presence or absence of ASE in the SH-SY5Y and SK-N-BE (2) neuroblastoma cell lines

Test substance	SH-SY5Y		SK-N-BE (2)	
	Pg/ml	% of inhibition	Pg/ml	% of inhibition
Capsaicin 300 nm + ASE 1 ppm	27.2±2.9	97.7	5.3±1.3	79.0
Capsaicin 300 nm + ASE 10 ppm	24.6±3.8	104.0	4.6±0.2	108.4
Capsaicin 300 nm	66.6±11.9	0	7.2±0.8	0
Control	26.3±2.1	100	4.8±1.2	100

- A test was performed by *Aruna K. Singh1 et al.*, rat-paw oedema model induced by phlogistic agent carrageenan. The Group I animals (control) received normal saline orally, Group II rats (reference) were orally administered phenylbutazone at 100 mg/kg P.O. The Groups III and IV animals received the test extract orally at 200 and 400 mg/kg, P.O. Carrageenan, prepared as 1% suspension solution and injected into the planter aponeurosis of right hind paw of each rat. The mean oedema volume of rats of Group I (control), II (phenylbutazone) and III and IV (ASE 200 and 400 mg/kg, P.O.) were 0.47±0.19 ml, 0.13±0.05 ml, 0.27±0.10 ml and 0.22±0.08 ml, respectively. The results showed that ASE (200 and 400 mg/kg, P.O.) produced significant inhibition of carrageenan-induced acute paw oedema in rats compared to control. The percentages of inhibition of oedema were 42.55 and 53.19 at 200 and 400 mg/kg doses of ASE. Phenylbutazone (100 mg/kg), inhibited the oedema volume by 72.34% [15].
- Another similar test was performed by *Ranajit Kumar Khalua et al.*, rat-paw oedema model induced by carrageenan. To Group-I animals carrageenan given in sub-plantar tissue of right hind paw, 0.1 ml of 1% suspension solution in 0.9% Nacl solution. Group-II were treated as negative control and Group-III were administered indomethacin as standard. Ethanolic and aqueous extracts given to the rats of Group-IV and Group-IX (Table 9, 10, 11) [23].

Table 9: Anti-inflammatory activities of aqueous extracts and ethanolic extracts of *Alstonia scholaris*

N=5 (in mm)	0 hours	30 min	1 hour	2 hours	3 hours	4 hours
Carrageenan (control)	2.01±0.07	3.34±0.06	3.9±0.03	3.99±0.09	3.95±0.95	3.9±0.02
Carrageenan + indomethacin (10mg/ kg)	2.05±0.05	3.0±0.05	2.96±0.07	2.25±0.04	2.2±0.06	2.03±0.7
Carrageenan + *Alstonia scholaris* (100 mg/ kg)	2.03±0.01	3.28±0.05	2.7±0.04	2.65±0.03	2.49±0.03	2.12±0.01

Table 10: Percentage inhibition of inflammation of aqueous extracts of *Alstonia scholaris*

% Inhibition	30 min	1 hour	2 hours	3 hours	4 hours
Carrageenan + *Alstonia scholaris* (100mg/kg bw)	6.28	17.9	24.5	24.3	24.35
Carrageenan + indomethacin (10mg/kg)	11.3	24.1	43.6	44.3	47.94

Table 11: Percentage inhibition of inflammation of ethanolic extracts of *Alstonia scholaris*

% Inhibition	30 min	1 hour	2 hours	3 hours	4 hours
Carrageenan + *Alstonia scholaris* (100mg/kg bw)	1.8	30.7	33.5	36.9	45.6
Carrageenan + indomethacin (10mg/kg)	10	24.1	43.6	44.3	47.9

- *Sammia Shahid et al*. performed an *in vitro* experiment by synthesizing the Mgo nanoparticles and performed on the egg albumin. Here, 100 and 500 ppm Mgo nanoparticles in 0.3 ml egg albumin and 2.9 ml of phosphate-buffered saline. Similarly, 100 and 500 ppm solution of Diclofenac sodium added in 0.3 ml of egg albumin and 2.9 ml of phosphate-buffered saline. After incubation both of the sample and standard at 37^0 C for 20 mins and tested the absorbance against DMSO as a blank test the following results are observed (Table12, 13).

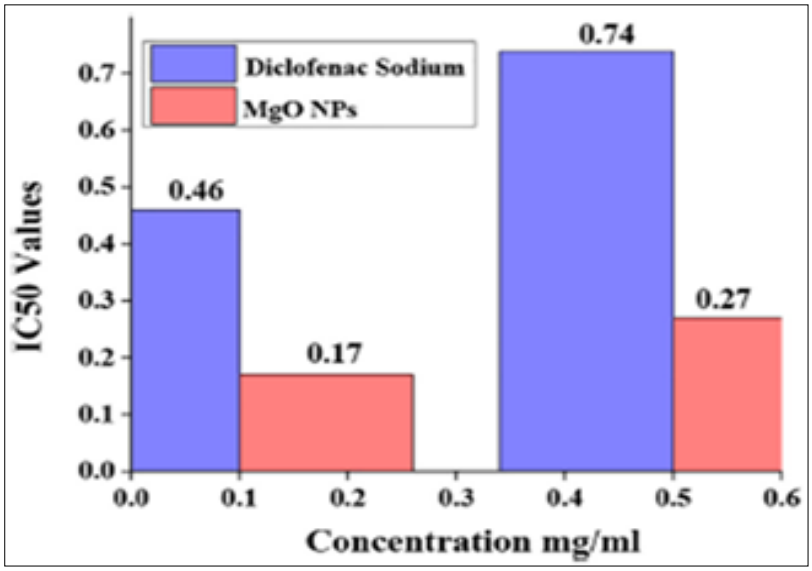
Table 12: Percentage inhibition and IC50 of standard (diclofenac sodium)

Concentration mg/ml	Absorbance of control	Absorbance of Mgo nanoparticles	% inhibition	IC 50
0.1 mg/ml	0.410	0.455	10.98	0.46
0.5 mg/ml	0.410	0.555	35.37	0.74

Table 13: Percentage inhibition and IC50 of sample (MgO) nanoparticles

Concentration mg/ml	Absorbance of control	Absorbance of Mgo nanoparticles	% inhibition	IC 50
0.1 mg/ml	0.410	0.531	29.51	0.17
0.5 mg/ml	0.410	0.724	76.59	0.27

Diclofenac sodium reduced protein denaturation up to 10.99% at 0.1 mg/ml and 35.37% at 0.5 mg/ml. Diclofenac sodium has an IC50 of 0.46 mg/ml at 0.1 mg/ml and 0.74 mg/ml at 0.5 mg/ml. MgO nanoparticles reduced protein denaturation up to 29.51% at 0.1 mg/ml and up to 76.59% at 0.5 mg/ml. MgO nanoparticles had an IC50 of 0.17 mg/ml at 0.1 mg/ml and 0.27 mg/ml at 0.5 mg/ml. The following chart shows the IC50 values of the standard (diclofenac sodium) and sample (MgO) nanoparticles [24].



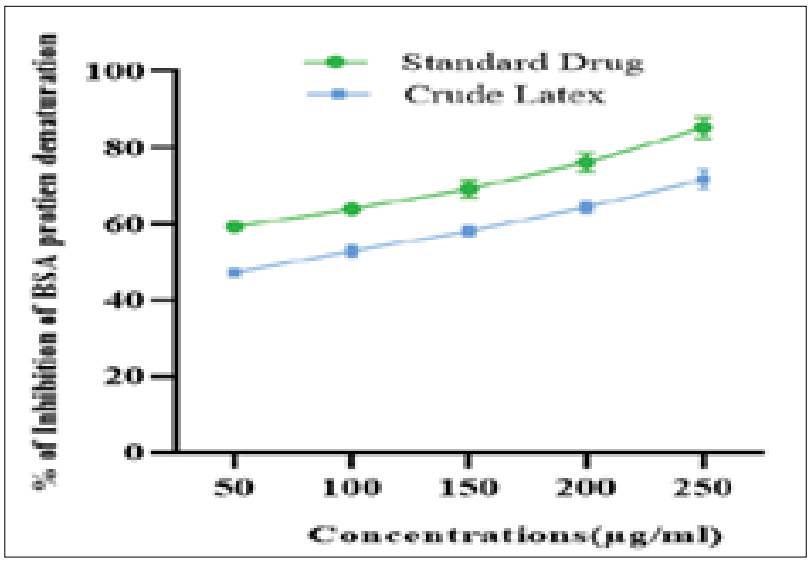
IC50 values of the standard and sample

- *Bapan Banik, Malay Kumar Das* investigated the anti-inflammatory effect of *Alstonia scholaris* by these 3 methods-BSA denaturation method, Egg albumin denaturation method, and Human Red Blood cell membrane stabilizing assay.

BSA denaturation method

The reaction mixtures were composed of varying concentrations (50, 100, 150, 200, and 250 µg/mL) of *Alstonia scholaris* latex + diclofenac sodium (reference), 1% w/v BSA and phosphate buffered saline (control). Then incubated at 37 ^{0}C for 20 mins.

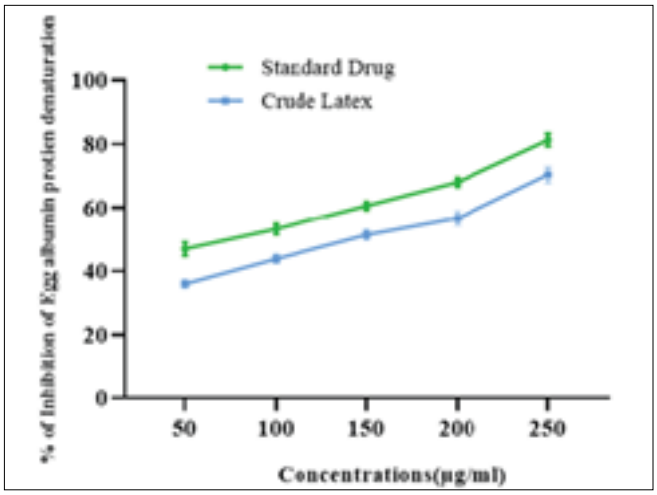
As a result, it showed that the AS latex showed significant amount of inhibition of protein denaturation when compared to standard at the concentration of 250 µg/mL. The AS latex showed 71.59±1.40% of inhibition. And the standard (diclofenac sodium) showed 85.23±1.56% inhibition of proteinase enzyme at 250 µg/mL.



Egg albumin denaturation method

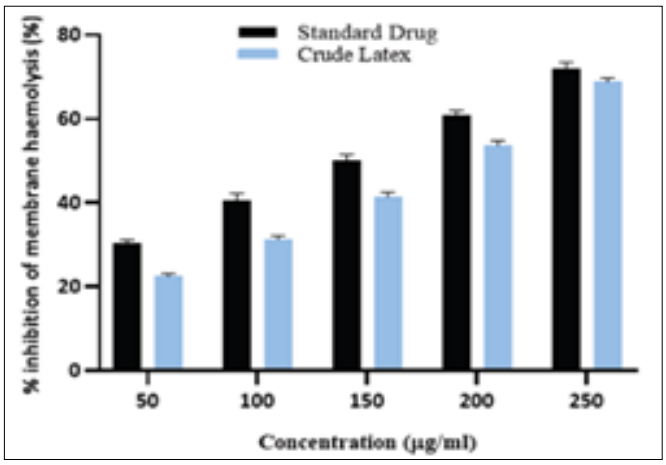
The reaction mixtures were composed of 0.2 mL of egg albumin + 2.8 mL of phosphate buffer solution + 2 mL of varying concentrations (50, 100, 150, 200, and 250 µg/mL) of AS latex. Here, 5 mL of double distilled water was used as control. Diclofenac sodium at 50, 100, 150, 200, and 250 µg/mL was used as the reference drug.

Result revealed that the latex, and diclofenac sodium showed the maximum inhibition of 70.42±2.38% and 81.32±1.92%, respectively, at 250 µg/mL.



Human Red Blood cell (HRBC) membrane stabilizing assay-The blood sample was collected from healthy volunteer and then mixed with equal volume of Alsever solution (2% dextrose, 0.8% sodium citrate, 0.5% citric acid and 0.42% NaCl). The collected cell suspension after centrifugation was cleaned with sterile saline solution (0.9% w/v NaCl) and centrifuged at 2500 rpm for 5 min. Various concentration (50, 100, 150, 200, and 250 µg/mL) of latex were prepared using distilled water. To each concentration, 1 ml of phosphate buffer+ 2 ml of hypotonic saline+ 0.5 ml of HRBC suspension were added. Then the mixture was incubated at 37°C for 30 min and centrifuged at 3000 rpm for 20 min.

In this assay, the latex showed considerable anti-arthritic activity in a concentration–dependent manner at 50–250 µg/mL. At the concentration of 250 µg/mL, the latex showed 68.77±0.565% inhibition of membrane haemolysis, where as the standard diclofenac sodium exhibited 72.12±0.785% protection of HRBC membrane in a hypotonic solution [25].



Anti-tussive Study

Yun-Li Zhao et.al performed a study to identify the effect of indole alkaloids of leaf extracts to treat post-infectious cough in mice by anesthetized with sodium pentobarbital. They left the control group without any interventions but model group received 5% carboxymethylcellulose; dexamethasone; TA-H; TA-M; TA-L; scholaricine; 19-epischolaricine; vallesamine; picrinine.

Serum was collected on 46th day after all of the above materials given. The serum samples were obtained by centrifuging the blood samples and stored at-80^{o} C for analysis of IL-6, CRP, SOD, MDA.

LPS and CS significantly increased the levels of cytokines IL-6 and CRP in the serum as compared to model animals up to 26.5±1.1 and 24.8±0. TA-L and scholaricine groups significantly reduced the level of IL-6 up to 22.7±0.6 and 22.2±0.9. CRP in TA-H and TA-L groups was markedly decreased up to 22.7±0.5 and 22.9±0.4.

For Broncho alveolar lavage fluid and cell enumeration the right lungs ligated and left lungs were lavaged with 1.5 ml PBS. Total cell number counted using blood counting instrument.

As a result, the number of WBC and neutrophils was increased in mice model up to 3.8±0.8 and 1.1±0.08. The number of WBC in TA-L group and Epi group were 1.1±0.3 and 1.6±0.5. The number of neutrophils in all the three TA groups as well as Pic group was 0.43±0.08, 0.54±0.08, 0.43±0.08, and 0.51±0.09 respectively.

So, this study confirmed that the content of pro-inflammatory cytokines (IL-6 and CRP) and lipid peroxidation products increased significantly. The animals exposed to LPS and CS exhibited a significant increase of neutrophils in BALF [9].

Study of Dysesthesia, Hyperalgesia

Hasandeep Singh et al. performed for investigation the presence of anti-dysesthesia and anti-hyperalgesia effect in the extract of *Alstonia scholaris.* In this study peripheral neuropathy by chronic constriction injury caused by doing four loose ligation was done on the gut with 1 mm spacing around the sciatic nerve in the left hind paw of mice. Extracts were mixed in 0.5% carboxymethyl cellulose. Group-I animals was unaffected; Group-II animals subjected to surgical procedure without neuropathic injury; Group-III animals were subjected to CCI; Group-IV animals received Pregabalin as a standard drug; Group-V-VI animals were subjected to chloroform extract and Group-VII-VIII animals were subjected to methanolic extract.

As a result, CCI increase the mechanical hyperalgesia in withdrawal threshold of hind paw in pinprick test as compared to control rats. Treatment of rats with pregabalin significantly amended the paw withdrawal reflex. Administration of chloroform and methanol extracts of *A. scholaris* markedly weakened the CCI-induced increase in nociceptive threshold. Methanol extract exhibited better fortification than chloroform extract against CCI-induced neuropathy in rats [14].

Anti-oxidant study

Anti-oxidant activity exhibits by identification of phytochemical constituents, demonstrated the ability to scavenge free radicals, inhibiting lipid peroxidation, increasing the activity of endogenous antioxidant enzymes, identification of anti-aging affects. *Sammia Shahid et al.* identified the anti-oxidant activity of the plant extract. They used the DPPH method and Phosphomolybdenum method.

DPPH method

Solutions of MgO nanoparticle and ascorbic acid were used as

a standard. To this solution, 4 ml of methanolic DPPH solution was added. Using methanol as a blank. As a negative control, a methanolic DPPH emulsion.

As a result, it revealed that the scavenging potential of the antioxidant compound was observed by the degree of discoloration. DPPH absorbs strongly at 517 nm and has a deep purple color. Color changed to pale yellow or colourless by reacting with the antioxidant compounds. As a results of the scavenging ability of the standard (ascorbic acid) and MgO nanoparticles, MgO nanoparticles have a higher proportion of scavenging than normal ascorbic acid and MgO nanoparticles have a lower IC50 value than other nanoparticles (Table 14,15).

Table 14: Percentage scavenging and IC50 of standard (ascorbic acid)

Concentration mg/ml	Absorbance of control	Absorbance of standard	% Scavenging	IC 50
0.05 mg/ml	0.940	0.820	12.77	0.20
0.125 mg/ml	0.940	0.668	28.94	0.24
0.25 mg/ml	0.940	0.597	36.49	0.37
0.5 mg/ml	0.940	0.501	46.70	0.51

Table 15: Percentage scavenging and IC50 of MgO nanoparticles

Concentration mg/ml	Absorbance of control	Absorbance of standard	% Scavenging	IC 50
0.05 mg/ml	0.940	0.730	22.34	0.11
0.125 mg/ml	0.940	0.540	42.55	0.15
0.25 mg/ml	0.940	0.350	62.76	0.18
0.5 mg/ml	0.940	0.290	69.14	0.24

Phosphomolybdenum Method for Antioxidant Activity

A reagent mixture was prepared by combining 16.7 ml H_2SO_4, 5.3 g of sodium phosphate, and 2.5 g of ammonium molybdate with 300 and 500 ppm of both MgO nanoparticle and standard (ascorbic acid). 4 ml reagent solution was combined with the MgO nanoparticles solution and Standard [24]. As a result, change in the solution color is observed that shows the reduction of phosphomolybdenum (Table 16).

Table 16: Percentage scavenging and IC50 value of the standard (ascorbic acid)

Concentration mg/ml	Absorbance of control	Absorbance of ascorbic acid	% Scavenging	IC 50
0.3 mg/ml	0.493	0.275	44.22	0.34
0.5 mg/ml	0.493	0.205	58.42	0.38

Table 17: Percentage scavenging and IC50 value of sample (MgO) nanoparticles

Concentration mg/ml	Absorbance of control	Absorbance of Mgo nanoparticles	% Scavenging	IC 50
0.3 mg/ml	0.493	0.225	54.36	0.28
0.5 mg/ml	0.493	0.137	72.21	0.25

Abbreviation

AS-*Alstonia scholaris;* HCL-Hydrochloric acid; EtOAc-Ethyl Acetate; MeOH-Methanol; CHCL3-Me2CO-Chloroform-Methanol; UV-Ultra Violet; RT-Retention Time; ASE-*Alstonia scholaris* extract; ATRA-All-trans Retinoic acid; HaCaT-cell-Human Epidermal Keratinocytes-cell; MCP-1-Monocyte Chemoattractant Protein-1; IL-8-Interleukin-8; MMP-1-Matrix Metalloproteinase-1; CGRP-Calcitonin Gene-Related Peptide; Mgo-Magnesium Oxide; IC50-Half-Maximal Inhibitory Concentration; BSA-Bovine Serum Albumin; HRBC-Human Red Blood Cell; PBS-Phosphate Buffered Saline; TA-Total Indole Alkaloid; CRP-C-Reactive Protein; SOD-Superoxide Dismutase; MDA-Malondialdehyde; CS-Cigarette Smoke; BALF-Bronchoalveolar Lavage Fluid; WBC-White Blood Cells; LPS-Lipopolysaccharide; CCI-Chronic Constriction Injury; DPPH-2,2-Diphenyl-1-Picrylhydrazyl; H2SO4-Sulfuric acid.

Discussion

Alstonia scholaris is an ornamental plant which is a native plant to tropical Asia, southern Bangladesh, India, Nepal, China, Sri Lanka, Australia, Pakistan. This plant has toxicity but it has mostly therapeutic activity. This review has done to gather information about the pharmacognostical, phytochemical and pharmacological properties of the plant. This plant also known by various names like, Blackboard tree, Scholar tree, Milkwood, Devil's tree, Indian pulai, White cheesewood, Dita bark, Bitter bark, Saptaparna, Saptachada, Chatraparna.

After many studies it was found that this plant contains various secondary metabolites like alkaloid, carbohydrate, amino acid, fixed oil & fats, phenol, terpenoid, cardiac glycoside, steroid, saponin, flavonoid.

After reviewing many literatures, it revealed that due to presence of these phytoconstituents it can be said that this plant can be test for identify the various activity like antimicrobial, anti-tussive, anti-inflammatory, anti-oxidant activities. The plant material needs to be study for various chronic pharmacological activities in future.

Conclusions

Phytochemistry explores the medicinal properties of herbs, essential in traditional medicine. Alstonia scholaris, known as the Devil's tree, holds a rich phytochemical composition, including alkaloids, terpenoids, and phenolic compounds. These compounds contribute to its traditional uses for various health issues like fever and cough. Pharmacognostical studies ensure the authenticity and safety of herbal products. Alstonia scholaris exhibits antibacterial, anti-inflammatory, anti-tussive, and antioxidant properties. These findings validate its traditional medicinal use and highlight its potential in modern medicine. Further research is crucial for harnessing the full therapeutic potential of this botanical treasure.

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