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A REVIEW ON PHYTOCHEMICAL CONSTITUENTS AND PHARMACOLOGICAL ACTIVITIES OF "*ALANGIUM SALVIFOLIUM*"

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ABSTRACT: In India, medicinal plants are commonly used by people as folk remedies and play a significant role in traditional systems of medicine such as Siddha, Unani, and Ayurveda. They are also utilized in pharmaceutical formulations. *Alangium salvifolium* has traditionally been used to treat a variety of ailments. In Ayurveda and Siddha systems of medicine, nearly every part of the plant including the roots, leaves, stem, and bark is utilized for managing different health conditions. The plant exhibits a wide range of medicinal properties, including laxative, astringent, pungent, anthelmintic, purgative, emetic, anti-protozoal, hypoglycemic, anti-diabetic, and anti-ulcer activities. It has also been reported to possess antifungal, antioxidant, antimicrobial, cardiotonic, and anti-fertility effects. These pharmacological actions are attributed to the presence of key phytochemical constituents such as flavonoids, saponins, glycosides, alkaloids, and steroids. The present review aims to provide a comprehensive overview of the literature related to the plant's pharmacognosy, phytochemistry, traditional uses, and pharmacological activities.

INTRODUCTION: *Alangium salvifolium*, which is commonly known as sage-leaved alangium, is a flowering plant of Cornaceae family. In India, It's mostly found in dry regions in plains and low hills and also found on road side [1]. The genus consists of 17 species of small trees and shrubs. It has antihypertensive properties and serves as an antidote for various poisons, including rabies. The roots are externally applied to treat rheumatism and inflammation, while the fruits are used in the treatment of haemorrhages [2].

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It is a well-known medicinal plant traditionally used in India and it is also one of the most adaptable medicinal plant possesses a wide spectrum of biological activities, including antidiabetic, antiulcer, analgesic, anti-inflammatory, antimicrobial, antioxidant, anti-arthritic, diuretic, antifertility, anthelmintic, antiepileptic and antifungal [3].

TABLE 1: CLASSIFICATION OF *ALANGIUM SALVIIFOLIUM* ACCORDING TO BENTHAM AND HOOKER'S [4]

Kingdom	Plantae
Class	Dicotyledons
Order	Cornales
Family	Alangiaceae
Genus	Alangium
Species	*Alangium salvifolium*

TABLE 2: VERNACULAR NAMES [4]

Sanskrit	Ankola, Ankota, Nikochaka, Deerghakeela
Kannada	Ankolimara, Ansaroli, Ankol
Malayalam	Ankolam, Velittanti
Telugu	Ankolamu, Udagu
Bengali	Akarkanta, Baghankura
Gujarati	Ankol, Onkla
Marathi	Ankola
Hindi	Angol, Ankora, Dhera
English	Sage leaved Alangium
Tamil	Alangi, Ankolum

Morphology [5]:

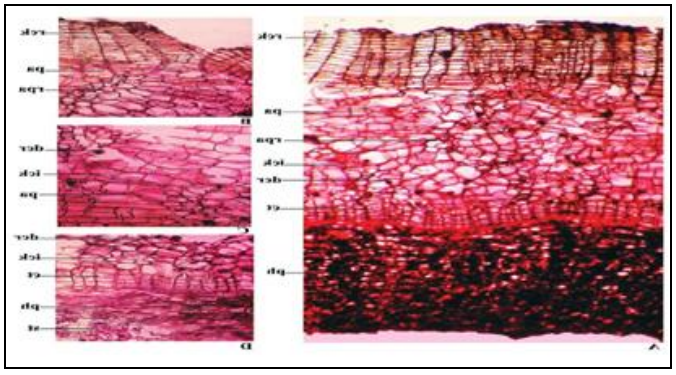
Leaves: Alternate, simple, without stipules petiole up to 1.5 cm long, hairy; blade elliptical to obovate, oblong or lanceolate.

Flowers: Bisexual, regular, 5–10-merous, white, cream with a slight orange tinge, fragrant; buds cylindrical; pedicel 2–8 mm long, stamens 10–32, 5–14 mm long; ovary inferior, 1–2-celled, style 8.5–27.5 mm long, glabrous, stigma conical or head-shaped, slightly lobed.

Fruits: The berries are ovoid, ellipsoid or nearly globose, glabrous, smooth and violet to purple.

Seeds: Seeds are albuminous. It can be propagated by seed and is reported to have a fairly good natural regeneration.

Microscopy:



Microscopy of *A. salvifolium* root bark. A. Detailed TS, B. A portion enlarged to show dividing phellem, C. A portion enlarged to show irregular phellem, D. A portion enlarged to show cortex and phloem. ct-cortex; DCR-DR use crystals of calcium oxalate; ick-irregular phellem; pa-parenchyma; ph-phloem; rpa-radially dividing parenchyma; st-sieve tube [6].

The stomatal index and stomatal frequency of *Ailanthus salvifolium* leaves are 52.63 and 65 per square millimeter, respectively. The vein islet number is 11.4 per square millimeter, while the vein termination number averages 13 per square millimeter. Organoleptic evaluation indicates that extracts from different plant parts are odorless and tasteless. Under fluorescent light, leaf powder exhibits varying colors in different extracts.

A transverse section (TS) of the root bark shows an outer phellem, a broad zone of irregularly developed phellem forming a rhytidome, a narrow cortex, and phloem. The well-developed phellem measures 0.1–0.15 mm in width. In some regions, successive phellem layers, five or more in number, alternate with parenchymatous tissue due to the formation of phellogen at different levels in the outer phloem. The parenchymatous tissue between phellem layers consists of slightly obliterated phloem elements and parenchyma cells, some of which contain druse crystals of calcium oxalate, measuring 18–30 µm in diameter.

The phloem extends from the cambial zone to the phellem, with uniformly thin-walled and regularly arranged cells. However, cells near the phellem exhibit radial divisions and are larger in size. The phloem region lacks sclerenchyma cells. The cambium is a narrow zone composed of 4–5 rows of thin-walled, regularly arranged cells measuring 12–27 µm tangentially and 6–9 µm radially [3].

Chemical Constituents [4]: The phytoconstituents found in different parts of the plant are as follows:

Root: Contains alkaloids such as cephaeline, tobulosine, isotobulosine, psychotrine, and alangiside.

Root Bark: Composed of alkaloids A & B, along with alangicine, d-methylpsychotrine, marckine, marckidine, and lamarckinine.

Leaves: Contain alkaloids like alangimarkine, ankorine, deoxytobulosine, and alangiside, along with sterols and three triterpenoids.

Fruits: Include alkaloids such as cephaeline, N-methylcephaeline, deoxytobulosine, and alangiside.

Seeds: Contain alkaloids like alangimarine, alamanine, alangimaridine, emetine, cephaeline, and psychotrine.

Medicinal Properties [2]:

Ankol roots	Analgesic, Anti-inflammatory, Anti-arthritic Anti-rheumatic, Antispasmodic, Muscle relaxant Carminative, Anthelmintic, Anticancer, Anthelmintic Antiprotozoal, Anti-hypertensive, Hypoglycemic Antipyretic.
Ankol seeds	Antidiabetic, Anticancer, Diuretic Anti-Inflammatory Antimicrobial, Laxative, Antiepileptic
Ankol oil	Antipruritics (Ankol Oil), Demulcent (Ankol oil)
Ankol fruits	Laxative or Purgative, Aphrodisiac, Expectorant, Carminative, Antidote of snake bites, Antidote of scorpion stings.
Ankol stem	Anti-diarrheal, Antiemetic.
Ankol leaves	Analgesic, Anti-rheumatic.

Pharmacological Activity:

Antidiabetic Activity: The alcoholic extracts of leaves, bark, and seeds demonstrated a significant ($p<0.01$) effect on glucose tolerance. Additionally, the seed and leaf extracts effectively inhibited diabetes induced by alloxan and streptozotocin–nicotinamide. The extracts also led to a significant reduction in elevated levels of SGOT, SGPT, ALP, bilirubin, urea, and creatinine in rats [7].

The methanol extract of *Alangium salvifolium* seeds has been proven in vivo to be a potent hypoglycemic and anti-hyperglycemic agent, suggesting its potential use in managing both Type I and Type II diabetes mellitus. The possible mechanism by which the seeds lower blood sugar levels may involve enhancing the insulin effect in plasma by either stimulating pancreatic insulin secretion from the β-cells of the islets of Langerhans or promoting its release from the bound form. Several other plants have also been reported to exhibit hypoglycemic activity through insulin release stimulation [8].

Antiprogesterogenic Activity: The ethyl acetate, chloroform, and aqueous extracts of *Alangium salvifolium* have demonstrated antiprogesterogenic activity, exhibiting abortifacient effects with minimal anti-implantation activity.

This suggests that herbal drugs may possess anti-progesterone properties. Various extracts of the stem bark of *Alangium salvifolium* have been found to contain alkaloids, steroids, saponins, and flavonoids, while tannins and phenolic compounds were specifically detected in the methanolic extract [5].

Antibacterial Activity: Among the various leaf extracts of *Alangium salvifolium* tested for antibacterial activity, the hexane extract exhibited the highest zone of inhibition against *Listeria monocytogenes*. In contrast, the chloroform extract demonstrated the greatest inhibition against *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Salmonella typhi*. Meanwhile, the aqueous extract showed the highest inhibitory effect against *Vibrio cholerae* [9].

Antioxidant Activity: The antioxidant activity of callus and various plant parts of *Alangium salviifolium* was evaluated using the 2, 2 -diphenyl-1-picrylhydrazyl (DPPH) free radical and superoxide radical scavenging assays. The results indicated that all plant parts exhibited antioxidant activity. The highest DPPH radical scavenging activity (90.76 ± 1.14%) and superoxide radical scavenging activity (73.6 ± 1.45%) were observed in 8-week-old callus. Both the callus and different plant parts demonstrated superoxide radical scavenging activity. In the nitric oxide scavenging assay, the alcoholic extract of *A. salviifolium* root showed greater antioxidant activity than the aqueous extract, with inhibition percentages of 74.9%, 59.7%, and 83.5% for alcoholic extract, aqueous extract, and ascorbic acid, respectively. The EC50 values were 308.80 µg/ml, 450.8 µg/ml, and 201.32 µg/ml, respectively [5].

Anticancer Activity: The crude extract of *A. salvifolium* significantly reduced tumor growth and tumor cell viability, normalized hematological profiles, and increased the lifespan of EAC-bearing mice compared to the control group. These findings

suggest that the flower extract of *A. salvifolium* exhibits a remarkable antitumor effect [10].

Antifungal Activity: Inhibitory zones were observed and measured regarding antifungal activity of *Alangium salviifolium* against dermatophytes and *Candida albicans*. Hence, it show antifungal activity without causing local toxicity, suggesting its potential for developing an herbal treatment for certain dermatomycotic infections [11].

Antihypertensive Activity: A quaternary base was isolated from the water-soluble fraction of the alcoholic extract of leaves. The compound significantly lowered carotid blood pressure in anesthetized dogs. However, pre-treatment with eserine blocked this hypotensive effect, leading to an increase in carotid blood pressure. However, it was not observed in case of pretreatment with atropine [12].

Analgesic Activity: The methanolic extract of *Alangium salvifolium* roots has been evaluated for its analgesic and anti-inflammatory activities in animal models. It demonstrated a significant, dose-dependent reduction in carrageenan-induced rat paw edema and exhibited notable analgesic effects [9].

Anti-inflammatory: Leaves extract exhibited moderate to highly anti-inflammatory and anti-arthritis activity. It suggests that the anti-inflammatory and anti-arthritis activity of F6 and F7 due to the presence of polyphenol and flavonoids [13].

Diuretic Activity: Preliminary phytochemical screening of *Alangium salvifolium* revealed the presence of flavonoids, alkaloids, and steroids in both benzene and ethyl acetate extracts. At a dose of 250 mg/kg, all extracts significantly increased urine volume as well as the concentrations of Na^+, K^+, and Cl^- in the urine. Based on these findings, it can be concluded that the diuretic activity of *Alangium salvifolium* may be attributed to the presence of flavonoids in both extracts [14].

Anti-arthritic Activity: All extracts of *Alangium salviifolium* demonstrated significant anti-arthritic activity, with the chloroform extract showing the highest effect, followed by ethyl acetate, aqueous, petroleum ether, and methanol extracts. The observed anti-arthritic potential may be attributed to the presence of bioactive compounds such as flavonoids, saponins and steroids, which are known for their anti-inflammatory properties [15].

Anthelmintic Activity: Phytochemical screening of the ethanolic extract of *Alangium salviifolium* revealed the presence of several major constituents, including alkaloids, coumarins, terpenoids, cardiac glycosides, flavonoids, saponins, quinine, and phenols. Among these, polyphenols and flavonoids are known for their anthelmintic activity suggesting that these compounds may be primarily responsible for the observed effect. The results indicate that the ethanolic extract of *Alangium salviifolium* exhibits significant anthelmintic activity in a dose-dependent manner. Notably, the extract was able to kill the worms even at lower concentrations and within a shorter time compared to the standard drug Albendazole, supporting its potential as a natural anthelmintic agent [16].

Antiulcer Activity: By performing anti-ulcer activity on male wistar rats, it can be concluded that the ethanolic extract of *Alangium salvifolium* has a significant anti-ulcer activity at 400mg/kg and 800mg/kg dose that is in a dose dependent manner. The results were comparable with that of standard and control groups. The phytoconstituents present in ethanolic extract like flavonoids and phenolic compounds may be responsible for the said activity [17].

Antihyperlipidemic Activity: Repeated administration of *Alangium salvifolium* extracts significantly reduced blood glucose, urea, total cholesterol, and triglyceride levels, while increasing HDL-cholesterol levels. In alloxan-induced diabetic rats, serum levels of SGOT, SGPT, ALP, and bilirubin were significantly elevated ($p < 0.01$) compared to normal rats. However, treatment with *Alangium salvifolium* seed extracts led to a significant ($p < 0.01$) reduction in these elevated liver enzymes and bilirubin levels. The increased urea and creatinine levels observed under diabetic conditions may be attributed to enhanced protein catabolism, resulting in greater elimination of urea, nitrogen, and creatinine [18].

CONCLUSION: Ankola is a renowned medicinal plant in Ayurveda. The present study explores its pharmacognostical and pharmacological properties of Ankolah, including antioxidant, antimicrobial, analgesic, anti-inflammatory, antidiabetic, antifertility, antiulcer, antiepileptic, anti-arthritic, and anticonvulsant properties. Although numerous studies have been conducted on various parts of *Alangium salvifolium*, it has yet to be developed into a pharmaceutical drug. More research can be carried out on the plant to develop a drug with multiple therapeutic effects for future use.

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