

Therapeutic Uses of *Aphanamixis polystachya*: A Review

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ABSTRACT

Aphanamixis polystachya (wall.) parker belonging to Meliaceae family, a large evergreen tree found to grow in most of the hotter parts of India, as well as the lowlands and hill forests of Bangladesh, Malay and Ceylon. These herbal Plants have the phyto constituents such as phenyl compounds, coumarins, essential oils, terpenoids, monoterpenoids, diterpenoids, triterpenoids, steroids, alkaloids and other nitrogenous compounds. Ayurveda approves *Aphanamixis polystachya* (*A. polystachya*) in liver and spleen disorders, tumors, ulcer, dyspepsia, intestinal worms, skin diseases, leprosy, diabetes, eye diseases, jaundice, hemorrhoids, burning sensation, arthritis and leucorrhoea.

INTRODUCTION

The importance of medicinal plants in health care is not new¹. Plants have provided the basis of thousand years old sophisticated traditional medicine systems and are supporting mankind with new remedies². Ayurveda, whose history goes back to 5000 B.C., is one of the ancient health care systems. The Ayurveda was developed through daily life experiences with the mutual relationship between mankind and nature. The ancient text of Ayurveda reports more than 2000 plant species for their therapeutic potentials.³

Aphanamixis Polystachya

Aphanamixis polystachya of the Meliaceae family is a traditional plant with potential medicinal uses. *Aphanamixis polystachya* also known as *Amoora rohituka* is a valuable medicinal plant of meliaceae family which is abundantly found in India. *A. polystachya* bark is a strong astringent, antimicrobial, used for the treatment of liver and spleen diseases, rheumatism and tumors¹. Fruits are globular, smooth, yellow when ripe, seeds with scarlet. The seed has rich oil content which is non edible but a future source for biodiesel^{4,8}.

Description

Aphanamixis Polystachya (wall) parker is the large handsome evergreen tree, with a dense spreading crown and a straight cylindrical bole up to 15m in height and 1.5-1.8m in width. The plant *Aphanamixis polystachya* belonging from meliaceae family is also listed as *Aphanamixis polystachya* (wall) parker syn⁵.

Distribution

It is distributed in the sub-himalayan tract from gonda (uttar pradesh) eastwards to bengal, sikkim and assam up to 6000ft and in western ghats, chota nagpur, konkarn, andaman and adjoining hill ranges from the poona district southwards to tinnevely up to 3500ft. a genus of this tree is also found in the indo-malaysian region³. It is also common to West Sepik, East Sepik, Madang, Morobe, Western Highlands, Eastern Highlands, Southern Highlands, Western, Gulf, Central, Northern, Milne Bay, New Britain, New Ireland & Manus., from Asia and Oceania, China, Bhutan, India, Sri Lanka, Indochina, Burma, Thailand, Indonesia, and Malaysia. Within India, Goa, Nagpur, China, Malaysia, Vietnam and Laos⁵.

Botanical Classification

The botanical classification of the plant is as follows:

Kingdom : Plantae
Phylum : Magnoliophyta
Class : Magnoliatae
Sub class : Rosidae
Order : Sapindales
Family : Meliaceae
Genus : *Aphanamixis*
Species : *Polystachya*⁶

The traditional classification of the plant is as follows : Reign: Plantae, Under-reign: Tracheobiont, Division: Magnoliophyta, Classify: Magnoliopsida, Subclass: Rosidae, Family: Meliaceae, Kind: *Aphanamixis*.⁷

The plant has been reported to possess several medicinal properties, the stem bark is

astringent, bitter, vulnerary, digestive, anthelmintic, depurative, urinary astringent, ophthalmic and refrigerant.⁹ Cell growth inhibition In vivo cell growth inhibition was carried out.¹⁰ CNS depressant activity was carried out by Hole crosses test and Open field test.¹¹ Evaluation of *Aphanamixis polystachya* as a Source of Repellents, Antifeedants, Toxicants and Protectants in Storage against *Tribolium castaneum* is also done.¹² In vitro membrane stabilizing activity was done on the plant.¹³

Active Constituents

A number of glycosides have been reported from the seeds and bark. The fatty acid composition of the seeds has also been worked out. The seed oil was found to be comprised of the fatty acids: stearic, palmitic, oleic, α -linoleic, isomeric linoleic and α -linolenic acids. Three new glycosides have been obtained from the ethyl acetate extract of the seeds, viz., 3',4',5'-trihydroxyflavone-7-O- β -D-xylopyranosyl- β -D-arabinopyranoside²⁵; dihydrorobinetin-7-O- β -D-glucopyranosyl-O- α -L-rhamnopyranoside; stigmasta-5,24(28)dien-3 β -O- β -D-glucopyranosyl-O- α -L-rhamnopyranoside. The petroleum ether extract of the leaves yielded a neutral compound designated aphanamixol which was characterized as eperu-13-en-8 β , 15-diol. The different extract of the bark yielded a high number of constituents. These were identified as aphanamixinin. From the ethanolic extract of powdered stem bark a new saponin, poriferasterol-3-rhamnoside has been isolated and characterized.

The Isolation and Characterization of roots ethanolic extract of *Aphanamixis polystachya* yields three new compounds: limonoid and flavonoids along with aphanamixinin. A lignan polystachyol, two lignan glycosides, lyonoside and nudiposide, and a sterol, ergosta-4, 6, 8(14), 22-tetraen-3-one with stigmasterol, have been isolated from a MeOH extract of the dried bark of *Aphanamixis polystachya*. Two apo-tirucallane triterpenoids with six membered hemiketal, polystanins A and B and two new tirucallane triterpenoids, polystanins C and D were isolated from the fruits of *Aphanamixis polystachya*.⁶



The plant pacifies vitiated vata, and pitta splenomegaly, liver disorders, tumor, ulcer, dyspepsia, intestinal worms, skin diseases, diabetes, eye diseases, jaundice, hemorrhoids, burning sensation, rheumatoid arthritis and leucorrhoea.¹⁴

THERAPEUTIC USES

Different parts of *Aphanamixis polystachya* are known to possess various medicinal properties, as known by rural and mainly tribal peoples of India (Assam, Uttar Pradesh and Uttarakhand). The plant pacifies vitiated vata, and pitta splenomegaly, liver disorders, tumor, ulcer, dyspepsia, intestinal worms, skin diseases, diabetes, eye diseases, jaundice, hemorrhoids, burning sensation, rheumatoid arthritis and leucorrhoea.¹⁴ The bark is acrid, astringent, bitter, vulnerary, digestive, anathematic, depurative, urinary astringent, ophthalmic and refrigerant. It is useful in treating ulcers, beneficial in abdominal problems, liver and spleen diseases and in tumors. Pounded bark is made into poultice in treating rheumatism. The Seeds are anathematic, laxative and refrigerant. They are also useful in treating ulcers. The seed oil is used as liniments in muscular problems.¹⁵

PHARMACOLOGICAL ACTIVITIES

ANTI OXIDANT

The comparative antioxidant activity of various *A. polystachya* extracts in comparison to Vitamin C. Methanol and aqueous methanol extracts exhibited up to 3 fold better efficacy in various in vitro antioxidant assays. These in vitro results are supported by in vivo data. Rats supplemented with 50 and 100 mg kg⁻¹ of AP 110/82C resulted in dose dependent and significant improvement in oxidative status, as indicated by significant reduction in hepatic lipid peroxidation with simultaneous elevation in hepatic glutathione and catalase levels. These antioxidant studies proved superior efficacy of *A. polystachya* extracts and the potent fraction AP 110/82C. As AP 110/82C is of natural origin, it is a safe and effective intervention for free radical mediated diseases.¹⁶

ANTI CANCER

Amooranin, its methyl ester and monoacetate derivatives were tested at 1,2,4,6,8, and 10g/mL dose levels on MCF-7, HeLa, HEP-2, L-929 and Chang liver cells. Amooranin and its methyl ester exhibited maximum cytotoxicity at a 8g/mL dose level and there was a plateau from 6 to 8g/mL with MCF-7 cells. The greatest activity for the methyl ester was against MCF-7 and HeLa cells, having an IC₅₀ of 1.8 and 3.2g/mL, respectively. HEP-2 and L-929 cells had intermediate sensitivities with an IC₅₀ of 5.3 and 5.8g/mL, respectively. amooranin methyl ester demonstrated broad cytotoxic activity against a five cell line panel, representing a diverse group of human tumours, murine fibroblast, normal human Chang liver cells; and weak general cytotoxic activity was observed with only MCF-7 and HeLa cells. Relative to the tumour cells in the panel, normal human Chang liver cells seemed resistant. In spite of a potent cytotoxic effect against cultured cells amooranin methyl ester had no antitumour activity when administered to animals. This is probably because it was metabolized and excreted very rapidly. Evaluation of amooranin and amooranin methyl ester against a panel of human cell lines, to determine if any selective cytotoxicity is evident, is in progress.¹⁷

THROMBOLYTIC ACTIVITY

Atherothrombotic diseases occur as serious impacts of the thrombus formed in blood vessels. Various thrombolytic agents are used to dissolve the clots that have already formed in the blood vessels; but these drugs have limitations and can lead to serious and sometimes fatal consequences. In the study all the plant extracts showed moderate thrombolytic activity compared to negative control. This activity may be due to the fact that the extracts are rich sources of alkaloids, flavonoids, tannins and terpenoids which are said to exert clot lysis activity.^{18,19} Maximum clot lysis was visually observed when streptokinase (100 µl) was added to the clots. The clot lysis data are shown in Figure 1. With normal saline, 4.58 % clot lysis was seen, while n-hexane (APHE), ethyl acetate (APEA) and methanol (APME) extracts produced 12.4, 13.69 and 12.95 % clot lysis, respectively ($p < 0.001$, compared with negative control).¹

ANTI BACTERIAL ACTIVITY

The antibacterial effect of *Aphanamixis polystachya* (wall.) Parker leaf extract. Antibacterial activity of ethanolic extract of *Aphanamixis polystachya* (wall.) Parker leaf was evaluated using Kanamycin (30µg /disc) as standard by measuring the zone of inhibition in mm. Table-1 exhibits that the ethanolic extract at a dose of 500µg/disc showed moderate to good Antibacterial activity in comparison with standard Kanamycin (30µg /disc) against *Sarcina lutea*, *Staphylococcus aureus*, *Pseudomonas*, *Hafnia*, *Shigella boydii*, *Shigella sonnie*, *Escherichia coli*, *Shigella dysenteriae*, and *Salmonella typhi* with the zone of inhibition ranging from 8 to 20 mm. The highest zone of inhibition was observed against *Salmonella typhi* (20mm) and the lowest zone of inhibition was observed against *Sarcina lutea* (8mm). The blank discs (30 µl /disc) didn't show any zone of inhibition. Antibacterial activity of ethanolic extract of *Aphanamixis polystachya* (wall.) Parker leaf against different bacterial strains is tabulated in Table in terms of diameter of zone of inhibition in mm.²⁰

In vitro antibacterial activity of ethanolic extract of *Aphanamixis polystachya* (wall.) Parker Leaf

Bacterial strains	Diameter of zone of inhibition in mm		
	Kanamycin(30µg/disc)	Ethanolic extract (500µg/disc)	Blank(30 µl /disc)
Shigella boydii	26	11	0
Hafnia	25	10	0
Shigella dysenteriae	25	13	0
Escherichia coli	26	12	0
Pseudomonas	26	10	0
Salmonella typhi	28	20	0
Shigella sonnie	27	12	0
Staphylococcus aureus	27	9	0
Sarcina lutea	22	8	0

FUNGICIDAL ACTIVITIES

Antifungal activities of 25 isolated compounds against seven phytopathogenic fungi (*U. viciae-fabae*, *P. Dissimile*, *S. tritici*, *A. solani*, *P. infestans*, *B. fuckeliana* and *G. zeae*). Most compounds lack noticeable fungicidal activity except for aphapolynins C, rohituka-3 and aphapolynin A that have shown strong fungicidal activity against *U. viciae-fabae* and rohituka-15 and aphanamolide A exhibited complete control over *P. dissimile*. In addition, aphanamolide A showed moderate activity against *S. tritici*, while aphanamolide B and rohituka-9 showed weak activity. Aphapolynin E and rohituka-15 showed moderate activity against *U. viciae-fabae*, while aphapolynins D and aphanamolide A showed poor activity against *U. viciae-fabae*. Aphapolynins C, rohituka-3, rohituka-9, aphapolynin A and aphanalides H showed moderate activity against *P. dissimile*, while aphapolynins D, aphanamolide B and aphanalides G showed weak activity against *P. dissimile*. To *A. solani*, only aphapolynins D and aphanalides H displayed moderate activity. All the isolates displayed no activity to three fungi: *P. infestans*, *B. fuckeliana*, and *G. Zeae*.^{21,22}

ANTI-HEPATOTOXIC ACTIVITY

Antihepatotoxic activity of *A. polystachya* was evaluated on carbon tetrachloride (CCl₄)-induced liver injury in a rat model. The assessment of hepatoprotective activity was evaluated by measuring the activities of aspartate aminotransferase (ASAT), alanine aminotransferase (ALAT), alkaline phosphatase (ALP), acid phosphatase (ACP) and lactate dehydrogenase (LDH), serum total bilirubin and albumin and histology of the liver. The crude leaf extract significantly inhibits the enhanced ASAT, ALAT, ALP, ACP and LDH activities released from the CCl₄-intoxicated animals. The depressed value of serum albumin and the enhanced value of total bilirubin in plasma caused by CCl₄ intoxication are also ameliorated. The study showed that the crude ethanolic extract from *A. polystachya*

leaves provided protection against acute carbon tetrachloride-induced liver damage.^{23,24}

CONCLUSION

Aphanamixis polystachya belonging to the family of Meliaceae, having several bioactive constituents is reviewed with special emphasis on the biological activities. It is a tree found throughout India. It is popular in indigenous culture of medicine like Ayurveda, Sidha and Homeopathy. In the traditional medicine, various plant parts such as bark, leaves and seeds are used in different and severe complaints. *Aphanamixis polystachya* is found to have significant anti oxidant, cytoprotective, anti hepatotoxic, and thrombolytic activity. The extracts also found to have a partial anti microbial effects.

Further studies and investigations can be done on the plant to exploit the different bio active molecules which are responsible for the various activities of *Aphanamixis polystachya*.

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