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PHARMACOGNOSTIC AND PHYTOPHARMACOLOGY STUDY OF ACACIA PENNATA

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ABSTRACT

A large scrambling or climbing shrub with lots of prickles, Acacia pennata syn. Senegalia pennata is also known as Cha-oum and Climbing wattle. It is indigenous to South and South-East Asia and can be found in all of India, including the Himalayan regions up to 1700 metres. It's a very practical plant with tasty leaves. In India, the Ayurvedic and Siddha medical systems both employ plants for medicinal purposes. In Siddha, Acacia pennata is referred to as Indan, Indu, Iyak Koluntu (Tender leaves) and in Ayurveda as Aadaari, Ari, Latakhadira. The entire plant is used to treat leprosy, haemorrhages, wounds, pain, burns, and digestive issues. The stem and heartwood are used to treat leprosy. Asthma is treated and aggravated pitta is soothed with the plant's bark.

INTRODUCTION

In northeast India, a variety of plants and/or their products have long been used for therapeutic and nutritional purposes. "Climbing acacia," scientifically known as Acacia pennata (L.) Willd. and a member of the "Fabaceae" family, is one of these plants with high vegetative value.[1] Because of their high nutritional value, A. pennata leaves are eaten as a vegetable in Thailand and the northeastern region of India.[2,3] This large, prickly climbing shrub is widely distributed in Bangladesh, Bhutan, India, Myanmar, Sri Lanka, Southwest China, and Thailand, with an altitude range of 800-1500 metres.[4] For this plant, flowers appear in May through July.[1]

The majority of published works and scientific studies have listed numerous advantageous effects of A. pennata, which may be because it contains a variety of phytochemicals and/or bioactive moieties. However, academics and/or herbal researchers often overlook this nutrient-rich shrub because there isn't a single literary work that can effectively highlight all the pertinent informational details. As a result, the goal of the current work was to highlight the potential nutritional benefits of A. pennata by offering a current overview of the plant's many characteristics, such as ethnobotany, pharmacognostic parameters, phytochemical constituents, vegetative value, and pharmacological actions.

Plant profile

Kingdom: Plantae
Phylum: Tracheophyta
Class: Equisetopsida C. agardh
Order: Fabales
Family: Fabaceae
Genus: Acacia
Species: Acacia penata (L) wild

Common name

- English: Rusty mimosa
- Hindi: Agla bel, Biswal, shembi.
- Irula: kottuseengai
- Kannada: Kaadu seege
- Malayalam: Kakkinja, Kareencha, Karinija, Kattusinikka, Peincha, Kaariinja, Malainja
- Marathi: Shembarati, Shembi.
- Nepali: Arkhu
- Oriya: Gohira

- Sanskrit: Ari, Khadiravallari, Tamrakntaka, Vallikhadira, Shiliikhadira
- Tamil: Seengai, Vellai indu, Inthu, Kattintu, Kattuchikai
- Telugu: Guba korinda

Synonyms: *Senegalia pennata* (L) maslin

Phytoconstituent

- Taepeenin D, (+)-drim-8-ene, quercetin 3-O-β-D-glucopyranosyl-4-O-β-D-glucopyranoside, labdanolic acid, and 8,15-labdanediol were found to be present in the leaves of Acacia pennata, together with two diterpenoids and a flavonoid glycoside. Quercetin 4′-O-α-l-rhamnopyranosyl-3-O-β-d-allopyranoside, apigenin 6-C-[2″-O- (E)-feruloyl-β-d-glucopyranosyl]Isorhamnetin 3-Oα-l-rhamnopyranoside, kaempferol 3-O-α-l-rhamnopyranosyl-(1→4)-β-d-glucopyranoside, -8-C-β-glucopyranoside, and isovitexin.[6]

- A.pennata's aeril portion contains five flavonoid glycosides: (2R,3S)-3,5,7-trihydroxyflavan-3-O-α-l-rhamnopyranoside, (2S)Five, Seven-Dihydroxyflavan-7-Oβ-d-glucopyranoside-(4α→8)-epi-afzelechin-3-O-gallate, 2R(2R,3S)-(-4′,7-dihydroxyflavan–(α→8)(3) 5,7-dihydroxyflavone-6-C-β-boivinopyranosyl-7-O-β-d-glucopyranoside, 5,7-trihydroxyflavan-3-O-α-l-rhamnopyranoside, and 5,7-dihydroxyflavone 7- O-β-d-glucopyranosyl-8-C-β-boivinopyranoside.[7]

- In addition to other substances, the following were isolated: chrysin-7-O-β-dglucopyraniside, kaempferol 3-O-α-l-rhamnopyranoside, pinocembrin-7-O-β-d-glucopyranoside, koaburanin, and quercetin-3-O-β-l-rhamnopyranoside.[7]

Pharmacological property

1. Analgesic and Ani inflamettary activity

Analgesic and anti-inflammatory properties of the butanolic fraction of dried Acacia pennata (fabaceae) leaves were investigated in animal models. In mice, it demonstrated strong protective effects against chemical stimuli (formalin and acetic acid). Additionally, it caused the rats' threshold of sensitivity to pressure-induced pain to significantly increase. In the later stages of rat paw oedema caused by carrageenin, the extract showed an inhibitory effect. According to the findings, a peripheral mechanism linked to an anti-inflammatory effect—similar to that of NSAIDs—is involved in the analgesic effect. The pharmacological activities of this fraction may be primarily attributed to flavonoids, one of the classes of compounds described here.[8]

2. Antimalarial activity

The study identifies 17 flavonoid-glycosides (FGs) from Acacia pennata as potential antimalarial agents against PfDHFR-TS. Using molecular docking simulations, FG17 was found to be the best inhibitor, with a binding affinity of -10.4 kcal/mol and -10.8 kcal/mol. FG17 was found to be more effective than RJ1 and a non-toxic, bioavailable compound. This suggests FG17 could be used as a lead scaffold for creating antimalarial drugs.[9]

3. Anti-HIV activity

The study extracted a novel saponin from the ethanol extract of the Vietnamese medicinal plant Acacia pennata (L.) Willd stems. With an IC50 value of 2.0 ± 0.2 µM, the compound 21β-O-[(2E)-6-hydroxyl-2,6-dimethyl-2,7-octadienoyl] pitheduloside G (1) demonstrated strong anti-HIV-1 PR activity, whereas pitheduloside G (2) displayed less inhibition. When tested on human embryonic kidney 293T cells, both substances were nontoxic.[10]

4. Antifungal

Plant extract Minimum Inhibitory Concentration (MIC) values were ascertained by a serial dihition assay with tetrazolium violet reduction serving as a growth indicator. In order to accommodate fungal growth conditions, the method was adjusted, and 96-well microtitre plates were used to dilute the extracts. The antifungal growth was inhibited at the lowest concentration (MIC) after 24 and 48 hours. At the tested levels, the mubation seemed to be more fungistatio than fungicidal. A different method was employed by Motsei et al. (2003) to calculate the minimum inhibitory concentration (MIC) of medicinal plants; however, fungicidal and fungistatic activities could not be distinguished.[11]

5. Anti alzhiemer

The study assessed the plant Acacia pennata Willd., which is used in Thai cuisine, for its potential to prevent Alzheimer's disease. Tetracosane was the most effective inhibitor of the strong β-amyloid aggregation that A. pennata twigs demonstrated. Additional substances exhibited a moderate inhibition of β-amyloid aggregation and a weak inhibition of acetylcholinesterase.[12]

6. α-glucosidase and α-amylase inhibition

The antioxidant activity, phenolic compounds, and potential inhibition against α-amylase and α-glucosidase of Thai herbs were assessed. Acacia, holy basil, and yellow-berried nightshade had the highest total phenolic content. Shallot, garlic, and bitter gourd exhibited the highest levels of antioxidant activity. The amount of caffeine in the various herbs varied, with the highest concentrations of p-coumaric acid found in peppermint, galangal, and holy basil. The percentage of potential inhibition against α-amylase in acacia ranged from 0% to 58%. Certain culinary herbs have demonstrated promise in the management of hyperglycemia during the early stages of the condition.[13]

7. Anti cancer

The study used fractions of hexane, ethyl acetate, butanol, and water to assess the anti-cancer activity of A. pennata extract. The development of cancer may have resulted from the inhibition of Hedgehog/gliomaassociated oncogene signalling by hexane and ethyl acetate. Selective cytotoxicity was demonstrated by terpenoids and flavonoid glycosides against human pancreatic and prostate cancer cells.[5]

8. Anti oxidant

Using the β-carotene bleaching method, the antioxidant activity of the shoot tips of the methanolic cold extract was first reported.[14] Using DPPH radical scavenging activity, the antioxidant activity of the ethanolic hot extract twig was reported for the second time in 2008.[15] In 2009, antioxidant activity was once more documented through the use of DPPH radical scavenging activity.[16] In 2013, the bark extract's antioxidant activity was also reported using DPPH, ABTS, OH, FRAP, metal chelation, phosphomolybdenum reduction, and peroxidation inhibition. The bark extract was successively extracted with petroleum ether, acetone, and methanol.[17]

9. Antiherb

Plaque reduction assay was used to examine the anti-herpes simplex virus activity of the leaf aqueous extracts, and the extract exhibits a slight inhibition.[18]

10. Anti hyperlipedaemic

The plant's anti-hyperlipidaemic activity was investigated by blending it with water. It was decided to classify the residue as fibre and the supernatant as juice. It was discovered that the juice inhibited the solubility of micellar cholesterol, pancreatic lipase, and cholesterol esterase. It was discovered that bile acid and A. pennata fibre could bind together quite well. This suggests that it lessens the absorption and digestion of lipids.[19]

11. Antifungal

The anti-fungal assay was first used in 2007 to report the anti-fungal activity of dried leaves of acetone, hexane, dichloromethane, and methanol extract obtained by centrifugation at 3500 rpm in centrifuge tubes, taking into consideration its minimum inhibitory concentration.[20]

12. Larvicidal and Pupicidal actions on mosquitoes

The 1st–4th instar larvae and pupae of the dengue virus vector, Aedes aegypti, were used to test the mosquito larvicidal and pupicidal activity of the crude ethanolic extract and fractionated extracts of the shoot tips of A. pennata. Compared to the ethanolic extract, the fractionated extracts displayed a higher death rate. The plant extracts' activity indicated that a phytotoxin or phytotoxins might be created in 2017 to reduce mosquito vectors.[21]

13. Antilice activity

After a thorough investigation into the anti-lice properties of A. pennata, it was determined in 2017 that the anti-lice properties may be attributed to the presence of significant amounts of saponins, various long-chain fatty acids, their esters, and previously identified insecticidal metabolites.[22]

Pharmacognostic parameters of A. pennata

The physicochemical characteristics and precisely calculated pharmacognostic parameters of the plant act as distinguishing characteristics and offer specialised instruments for drug authentication, identification, classification, quality assurance, and control.[23] Therefore, for the proper identification and validation of the quality and purity of any crude drug, significant developments of all feasible pharmacognostic specifications are required. Similar to all other plants, A. pennata has a distinct set of microscopic and macroscopic features. Macroscopically and organoleptically, the leaves are bipinnate compound leaves that are 4 to 8 mm long and 1 mm broad, with linear to oblong leaflets that are tasteless, odourless, and greenish green in colour. The leaflets have sharp tips and truncate, glabrous bases with ciliated margins. The 2 cm long petioles have a plate-shaped gland near the middle or base; they have rachis grooves and are subtly prickled with glands opposite the top two pairs of pinnate. The midrib is somewhat prominent and located quite close to the distal edge, but the veins are obscure.[24] Further more, it has been reported that the plant's stem bark is approximately 3.90 cm thick, hard and woody in shape, and coloured between deep grey when fresh and greyish white when dried. It also has rough scars on the nodal region and signs of shrinkage on the surface when drying, as well as a long, tough, and woody texture. The bark's distinctive smell varies from pleasant, mild sweetness when fresh to odourless when dried, and it tastes sweet, juicy, and tongue-sensitizing.[25]

A plant's rachis consists of a single layer of rectangular cells in the epidermis, followed by 5-8 layers of angular parenchyma in the cortex, 3–4 layers of sclerenchyma in the ring of sclerenchyma, a larger patch of sclerenchyma, four vascular bundles surrounding a small pith, angular xylem vessels, and parenchymatous cells with starch grains in the pith. The epidermal cells of dorsiventral leaflets have thin walls and a slight sinuous shape. Palisade tissue, spongy mesophyll, and a single layer of polygonal cells make up the upper epidermis. An essential tool for histological interpretation is powdered microscopy. Polygonal cells with paracytic stomata, sclerenchymatous fibres, starch grains, pitted, scalar form, and spiral vessels are present in the leaves, which are greyish to yellowish green in colour.[24]

The characteristics of the powdered stem bark of A. pennata were also investigated by Terangpi and colleagues in 2013. They found that when the greyish white powdered stem bark was combined with a number of reagents, including acetic acid, conc. H_2SO_4, conc. HNO_3, conc. HCl, and aqueous NaOH solution, it changed into the typical colours of yellowish green, purplish brown, brick red, brownish black, and colorless respectively.[25]

CONCLUSION

The communication addresses both scientific and traditional knowledge regarding A. pennata, revealing 30 phytochemicals that have been isolated from the shrub and 26 traditionally claimed medicinal properties around the world. Only 14 confirmed pharmacological effects, nevertheless, have been documented to date. The review of the literature points to a paucity of validated pharmacological research on this possible nutraceutical shrub. A thorough analysis of A. pennata will raise awareness among those involved in the development of herbal-based medications and nutraceuticals, as well as promote integrative research aimed at improving the general health of society. The purpose of this review is to highlight A. pennata's potential for the development of nutraceuticals.

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