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THERAPEUTIC POTENTIAL OF THE SPONDIAS PINNATA -A REVIEW

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ABSTRACT The *Spondias pinnata,* also known as the Indian Hog plum, is a member of the Anacardiaceae family. It is a mild-deciduous tree that produces nutritious fruit. It has high nutritional value and is abundant in various nutrients and minerals. In traditional use, various components of *S. pinnata* are used to treat various ailments, such as dysentery, stomach problems, and hyperacidity. It can also be used to treat tuberculosis and other diseases. Various pharmacological activities have been reported using the extracts of S. pinnata. These include anti-cancer, anti-diarrhoeal, anti-microbial, anti-inflammatory, antipyretic, anti-hypertensive, anthelmintic, diuretic, and laxative. They can also reduce the side effects of chemotherapy and improve the quality of life for those suffering from sub-chronic and acute toxicity. Various phytochemicals of this plant have been studied. These include polysaccharides, amino acids, terpenoid compounds, flavonoids, steroids, and other substances. The structures of numerous important phytoconstitutions have been confirmed by solvent extraction and mass spectrometry. This review is a good reference material for researchers looking into the plant's potential applications.

KEYWORDS : medicinal plants, *Spondias pinnata*, therapeutic potential, phytoconstituents, antimicrobial

INTRODUCTION

Today, medicinal plants and herbs play a significant role in the advancement of human civilization. During the Vedic period, they have been used to cure and prevent various diseases alongside epidemics. Medicinal plants are also commonly utilized for preserving food and making condiments. All of the plant's components have unique medicinal properties. Nearly every part of the plant has its own medicinal heritage (Mahesh B et.al Agr Sci. 2008; 4(S):839–43). In the past, herbal medicines were commonly used as powders, teas, poultices, and even as an "angel compound." Many medicinal plants are often used as good condiments, to taste, to dye, to preserve food, etc. Information about their use is spread across various cultures and societies and passed down through generations. In the past couple of years, the number of people consuming plant-based health products has increased significantly in both developed and developing countries. This has resulted in the exponential growth of the herbal product industry. The Hog-plum is a small tree species that has a nutritious and high-protein content. It is highly nutritious and has a good amount of vitamin C and citric acid (Diabetes Care. 2010;33(Supplement_1): S62–S69). Although it is commonly consumed raw, hog plums can also be used to prepare various processed food products such as chutneys and pickles. Unfortunately, the shelf-life of these products is limited due to their enzymatic browning and bacterial spoilage.

Studies on the various species of Spondias revealed that they possess various characteristics, such as antioxidant, anti-proliferative, analgesic, hypoglycemic, anti-inflammatory, and anti-dementia (Saeedi P., Petersohn I., Salpea P., et al. 2019). The large number of phytoconstituents found in this group has contributed to their ability to produce various anti-hypertensive, anti-inflammatory, and anti-proliferative effects. The Spondias are characterized by various features, such as flavonoids, tannins, saponins, and triterpenes. They also contain essential oils, amino acids, and polysaccharides [Nwidu LL, Elmorsy E, Yibala OI, Carter WG 2017). The anti-diarrhoeal effect is due to the presence of flavonoids (Saralaya MG, Patel P et al 2010;2(2):35–39). Indian Hog plum is a tree belonging to the Anacardiaceae family that grows up to 25 meters tall. The fruits are tangy-twisty in taste, and the unripe ones are salty. These are used as a vegetable, and they are also eaten by mammals that are herbivorous.

In the Western Ghats of Karnataka, the leaves and flower buds of *S. pinnata* are used for making pickled products, while the bark is used to treat diarrhoea and dysentery. The roots are also consumed to regulate menstrual periods. *S. pinnata* is a vital plant that has a wide range of uses in traditional and ethnomedicinal programs. It is in high demand in natural habitats due to the domestic consumption of this species. The commercial exploitation of this plant occurs on a daily basis, and this has a particular focus on the utilization of ethnobotanical resources.

Characteristics of *S. pinnata*

Scientific classification

KINGDOM-Plantae
SUBKINGDOM -Tracheobionta
SUPERDIVISION -Spermatophyta
DIVISION -Magnoliophyta
CLASS -Magnoliopsida
SUBCLASS- Rosidae
ORDER- Sapindales
FAMILY -Anacardiaceae
GENUS- Spondias L.
SPECIES- *Spondias pinnata* (L.f.) Kurz

The *S. pinnata* is a deciduous tree that grows up to 25 meters tall. It has a branch with a yellow-brown colour and irregular cracks. The bark has a smooth and creamy appearance, and it is characterized by a turpentine smell. The internal and outer barks are separated into secondary phloem and periderm. Outer bark cork cells are simple and homogenous, and the calcium oxalate crystals found in the inner portion of the parenchyma randomly distribute. The phloem rays are also loaded with tannins. Powder barks are brown in colour with a slight turpentinic odour, and starch grains are present. Cork cells are also stratified, and they seem like benzene rings. Stone cells have an elongated shape, and phloema fibres are found in linear frameworks. The wood is characterized by a luminous colour, which doesn't exhibit any lustre or odour. It has a smooth texture, and its vessels are medium-sized. The wood with diffuse-porous pores has numerous pores, while the one with growth rings is indistinct. Vessels are characterized by their round shape and arranged in a section diagonally. Gum deposits and tyloses are also found in them. Ray cells house starch grains. The wood has a mild weight and a moisture content of 12% (Phongkrathung, Renupha & Vajrodaya, Srunya & Kermanee, Prasart 2016).

The leaves of *S. pinnata* are spiral, elliptical-oblong leaflets that are 25 to 45 cm long. They have an asymmetric base and acuminate apex. The midrib is flat above, and the secondary veins are obtuse and parallel. The stipules and tertiary veins are absent. The leaves of *S. pinnata* are green, while the dried ones are brownish green (Kunwar R. M. et al. 2010;6(1): p. 35).

Their anatomical structure can be observed on the abaxial and adaxial surfaces. Simple and short-celled trichomes are present on the surfaces. Intramarginal veins are rarely present in Anacardiaceae. The resin canals are present in the reproductive and leaves structures. They are located parallel to the phloem. In the minor veins, they are absent. The midrib has biconvex symmetry with vascular bundles. The mesophyll is located in the dorsiventral palisade layer, and the dermis is covered with an epicuticular wax layer. Parenchyma is associated with several layers in the intercellular spaces.

The angular collenchyma is located externally around the phloem and xylem. The leaves microscopic powder is characterized by a combination of starch grains, calcium oxalate crystals, and elongated stone cells.


Figure 1.1 Spondias pinnata bark


Figure 1.2 Spondias pinnata root


Figure 1.3 Spondias pinnata leaves


Figure 1.4 Spondias pinnata flower


Figure 1.5 Spondias pinnata fruits


Figure 1.6 Spondias pinnata tree

The spherical shape of the *S. pinnata* root is not uniform, and it has grey fissures and ridges on its outer surface. Its creamy white powder has no taste or odour, and the bark cannot be easily scraped. The tree's mature root measures about 5-8 meters long. Its microscopic characters show that it has a vascular cylinder and a wide periderm. The periderm features membranous with small fissured openings that are filled with phellogen and phellem cells. The cells are radially arranged and have rectangular brick-like structures. There is a narrow stripe in the phellem's centre. The wide cortex is composed of parenchyma cells that are elongated, and phloem and sieve tubes are present in the secondarily wide phloem. The xylem vessels are between the medullary rays, and the root powder is made up of cork cells, fibres, and vessel components.

The Epicarp is a simple, round, succulent, single-seeded fruit that's about 1.5 to 2.5 cm long and 0.7 to 1.3 cm wide. It has a fleshy pulp that's safe to eat. When ripe, the Epicarp is tangy and juicy. On the other hand, when it's in its mature stage, it's aromatic and has a hard, woody, and grooved outer surface. The Epicarp is characterized by its sour taste when unripe. On the contrary, the fruits that are ripe have a tangy taste with a pleasant aroma. The seeds have ridges and a semi-woody outer surface.

White flowers with a stalkless appearance and a triangular sepal shape. The calyx features five light lobes that are narrow and triangular. The flowers of the calyx are white and glamorous. The petals of the ovate are 2 to 3 millimetres long and 1.5 to 2 millimetres wide. The androecium features five stamens, which are inserted into the base of the disk. The anthers are also thin. The ovary has five stout patterns and is filled with pollen grains. The calyx's inflorescence features first-order branches that are paniculate, terminal, and glabrous. The flowers are arranged on a plant that is polygamous. The flowers appear earlier than the leaves, and they are accompanied by very young ones. The period between June and October is when the flowering begins. During the spring, the flowers are on naked shoots.

Nutritive and Mineral Potential

The robust fruit of *S. pinnata* is a popular choice in the food and nutritional supplements industries due to its high protein and fiber content, as well as its low energy. This fruit has a high amount of vitamin C and is commonly used in various food and beverage preparations. It is pickled in brine and is used in a wide range of recipes, such as jams, sherbets, and condiments. The end results of *S. pinnata* are generally acidic. Fresh fruits of this plant are commonly used in making sauces, and they show that the interactions between vinegar, sugar, and water have a significant impact on the improvement of Hog plum sauce's acceptability (C. P. Suresh et al., Journal of Tree Sciences, 2014). Compared to vinegar, sugar had a stronger influence on the universal acceptability of the product.

Nutritive and mineral potential of ripe fruits of Amra or *Spondias pinnata* (Purohit, V.K et al., 2010)

Energy	189–203 kcal/g
Crude fat	12.23–12.54%
Crude fiber	3.13–4.03%
Total carbohydrate	16.30–23.54%
Sodium	0.96–1.38%
Calcium	0.15–0.93%
Iron	1.3–1.5%
Copper	0.9–1.23%
Protein	0.50-0.80%
Acid	0.47%

Aboriginal Drug Programs

Plants of the genus Spondias, consisting of 18 species, have been used as a traditional medicine to treat various diseases (Jain P et al 4(2): 183–195). *Spondias pinnata* is used in various forms of medicine, such as Ayurveda, Siddha, and Unani. It can be used to treat various diseases and conditions, such as diarrhoea, dysentery, and tuberculosis. In addition, the bark paste can be used to treat painful joints and stomach discomfort. In addition to treating dysentery and diarrhoea, the bark juice can also be applied to treat various skin diseases and ringworm. The leaves juice is used to treat earache. The fruit itself is used to treat various conditions, such as earache and blood dysentery. The root is utilized to control menstrual periods. The stem bark of *Spondias pinnata* has characteristics such as Karma, Guna, and Rasa. In terms of their therapeutic applications, these are referred to as daha, ksata, raktapitta, and ksaya in Indian medicine (Patathananone S et al (2019) 35(3):1-12). The dried stem bark is usually sold as a powder for decoction and for medicinal purposes. However, it is not recommended for individuals with high pitta and pitta dosha due to the sour nature of the unripe fruit. On the other hand, ripe fruits are ideal for gastritis.

Antidiarrhoeal Activity

The S. pinata bark extract has been shown to have anti-diarrheal properties in Wister rats that have been infected with diarrhoea caused by the use of castor oil. They were given a single ml of the oil and then examined for the quality of fecal matter. The animals were then treated with varying amounts of the extract. The extract can also prevent hydrolytic secretion and intestinal agitation. It exhibits the anti-diarrhoeal effect due to the presence of flavonoids (Saralaya MG et al 2010;2(2):35–39). In addition, the aqueous extract of the S. pinata fruit was found to be effective against diarrhoea in Wistar rats. For the study, the extract was administered orally using a concentration of around 100, 200, and 400 mg/kg. It exhibited significant anti-diarrheal properties against both magnesium sulphate-induced and castor oil diarrhoea10. The evaluation of the extract's anti-diarrhoeal impact was comparable to that of Loperamide, a well-known drug. A combination of aqueous extracts and methanol can be used to develop in vitro anti-bacterial properties of *S. pinnata* barks by cup-plate diffusion at concentrations ranging from 50 to 150 mg.

Anti-Microbial Activity

A crude extract of *S. pinnata* has been reported to show antibacterial activity (Bibitha B. et al. 2002; 42:361–363). They utilized standard antibiotics like streptomycin and penicillin. The methanol extract exhibited better anti-bacterial properties against various pathogens, such as *E. coli* and *V. cholera*(Li R et al. 2020 Jan 15;25(2):343). On the other hand, the aqueous extract only exhibited moderate anti-bacterial activity against these infections. The antibacterial properties of the resin extracts of Saccharomyces pinnata have been studied against various pathogens, including *Escherichia coli*, Acinetobacter spp., and subtilis. Disc diffusion and microdilution techniques were utilized to analyze the in vitro activity of the resin extracts. It was revealed that subtilis was the most susceptible organism. The results of the studies revealed that the resin extracts inhibited the growth of various bacterial species, such as subtilis and Gram-negative bacteria (Li R et al. 2020 Jan 15;25(2):343). They also exhibited anti-bacterial properties against fish pathogens. In addition, the chloroform and ethanol extracts from the roots of *S. pinnata* exhibited promising anti-bacterial properties against different pathogens, such as *V. cholerae* and *S. Typhi*.

Thrombolytic Activity

The exocarp of the *S pinnata* fruit was used to deliver thrombolytic action. This procedure was carried out using a strategy developed by Daginawala using streptokinase. The test revealed that the exocarp has a critical thrombolytic action (Manik et al (2013) 191-201). The fruit's

ethanolic extract inhibited haemolysis. The *S pinnata* leaf extract was also used as a potential drug for thrombolytic activity. The fraction of soluble ethyl acetate produced the highest number of clot lysis. Compared to the other two methods, the fraction of soluble ethyl acetate produced the most effective thrombolytic activity.

CONCLUSION

The various constituents and parts of the plant species *S. pinnata* have been studied to determine their therapeutic potential. Through the use of various screening models, researchers were able to identify potential applications for this plant. The previous studies carried out on this plant indicated that it could be used for the development of medicines. There are many advantages to every component of *S. pinnata*. Some of the components of *S. pinnata* extracts contain various phytoconstituents. These include amino acids, carbohydrates, terpenoids, flavonoids, steroids, and polysaccharides. The chemical constituents of these substances were studied and their structures were established. They are known to exert various pharmacological effects, such as anti-cancer, anti-diarrhoeal, anti-microbial, anti-inflammatory, anti-oxidant, anti-hypertensive, and anthelmintic. They can also reduce the side effects of various drugs, including chemotherapy and ameliorate the effects of platelet aggregation. Gas chromatography-mass spectrometry and solvent extraction techniques confirmed the structural characteristics of some of the essential phytoconstituents of *S. pinnata*. This review mainly analyzed the studies on the therapeutic potential of this plant**.** The information presented in this review, along with the necessary studies to confirm its medicinal properties, should encourage the appraisal of its usage.

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