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Pongamia pinnata(L.) A Plant Rich In Beneficial Properties

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Abstract

This plant is very important. Scientific studies have proven that different parts of *Pongamia pinnata* (L.) have various properties, including deworming, antioxidant, antibacterial, anti-plasmodial, anti-cancer, antidiarrheal, lice-killing, neuroprotective, anti-inflammatory, antiviral, and anti-filarial properties. It has great potential for future biodiesel production and is also useful in the textile industry. Its flowers nourish bees and various insects, and it plays an important role in nitrogen fixation. Its oil is also very valuable. Tribal communities have been using different parts of *Pongamia pinnata* since ancient times.

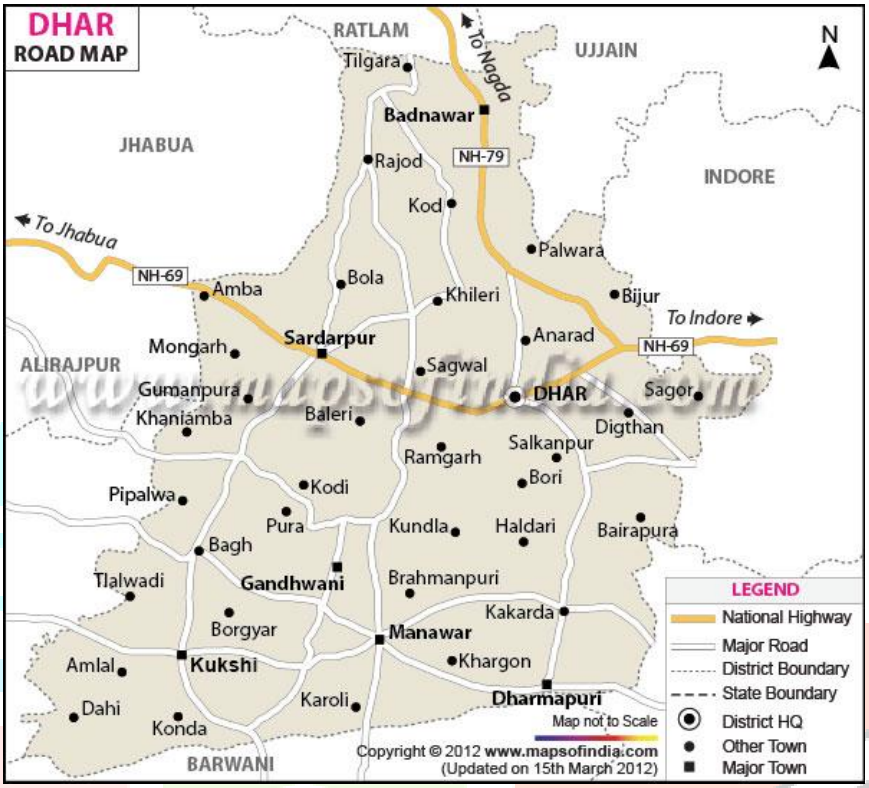
key word : *Pongamia pinnata(L.)* **,**Biodiesel **,** Nitrogen Fixing, Antihelminthic activity **,** Antibacterial , Antiviral activity

Introduction

Pongamia pinnata (Linn.) Pierre is a medium-sized tree with smooth leaves, known in Hindi as 'Karanj'. It is a medicinal plant recognized for its diverse benefits and its potential as a source of biodiesel. Its seeds contain an average of approximately 28–34% oil, which is rich in polyunsaturated fatty acids. Historically, Pongamia has been utilized in traditional medicine, particularly within the Ayurvedic and Siddha systems of Indian medicine. Various parts of the plant have been used as crude remedies to treat conditions such as tumors, hemorrhoids, skin diseases, itching, boils, joint pain (arthritis), wounds, ulcers, and diarrhea. Additionally, it serves , green manure, a source of timber, and a fish poison.

Study area

Dhar is situated between 21°57' to 23°15' N and 74°37' to 75°37' E. The city is bordered in the north by Ratlam, to the east by parts of Indore, in the south by Barwani and to the west by Jhabua and Alirajpur. The town is located 34 miles (55 km) west of Mhow. It is located 559 m (1,834 ft) above sea level



Research Methodology

I conducted a detailed study by visiting the forest and its surrounding areas at various times and gathered information about this plant from the local people; during this process, I paid special attention to aspects such as its flowering and fruiting seasons and its economic significance. I studied numerous important research papers available on platforms like the National Library of Medicine, PubMed, Semantic Scholar, Google Scholar, and ResearchGate. Additionally, I took photographs using my mobile phone camera.

Classification

Scientific classification

Kingdom:Plantae

Clade:Tracheophytes

Clade:Angiosperms

Clade:Eudicots

Clade:Rosids

Order:Fabales

Family:Fabaceae

Subfamily:Faboideae

Tribe:Millettieae

Genus:Pongamia

Adans. (1763), nom. cons.

Species:*P. pinnata*

Binomial name *Pongamia pinnata (L.) Pierre* (1898)

synonym

Cytisus pinnatus L.

Dalbergia arborea Willd.

Derris indica (Lam.)Benn.

Galedupa indica Lam.

Galedupa pinnata (L.)Taub.

Galedupa pungum J.G.Gmel.

Millettia novo-guineensis Kaneh. & Hatus.

Millettia pinnata (L.)Panigrahi

Pongamia glabra var. xerocarpa (Hassk.)Prain

Pongamia glabra Vent.

Pongamia mitis (L.)Kurz

Pongamia mitis var. xerocarpa (Hassk.)Merr.

Pongamia pinnata var. xerocarpa (Hassk.)Alston

Pongamia xerocarpa Hassk.

Pterocarpus flavus Lour.

Robinia mitis L.

Common Name : Karanj, Pongam Tree, Indian Beech Tree, Pongame Oil Tree

World Distribution

Andaman and Nicobar Islands, Australia, Bangladesh, Bismarck Archipelago, Bhutan, Borneo, Caroline Islands, China, Christmas Island, Fiji, Hainan, India, Japan, Jawa, Lesser Sunda Islands, Malaya, Marianas, Myanmar, Nansei-shoto, New Caledonia, New Guinea, Pakistan, Philippines, Samoa, Sri Lanka, Sumatera, Taiwan, Thailand, Vanuatu, Vietnam, Wallis-Futuna Islands

Native

Andaman and Nicobar Islands, Australia, Bangladesh, Bismarck Archipelago, Bhutan, Borneo, Caroline Islands, China, Christmas Island, Fiji, Hainan, India, Japan, Jawa, Lesser Sunda Islands, Malaya, Marianas, Myanmar, Nansei-shoto, New Caledonia, New Guinea

About *Pongamia pinnata* Plant

Habit : A deciduous tree.

Leaves :Imparipinnate leaves.Leaflets 5-9, opposite, ovate-oblong, acute, stipules long.

Inflorescence : Axillary racemes.

Flowers :White or purplish, bracteoles ovate.

Calyx :campanulate, purplish, corolla pinkish-white, standard suborbicular, wings obliquely oblong, keel obtuse, stamens 10, monadelphous, anthers versatile.

Ovary :Ovary 2-ovuled, style incurved.

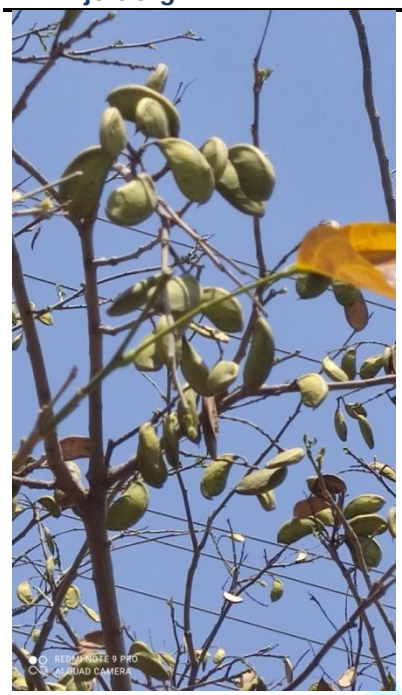
Fruit : Pod obliquely-oblong, compressed, woody, 1-seeded.

Flowering and Fruiting Time : April - June

Pongamia pinnata(L.)Plant

Pongamia pinnata(L.) Plant

Pongamia pinnata(L.)Plant Flowering twing



*Pongamia pinnata(L.)*Plant fruit

*Pongamia pinnata(L.)*Plant fruit

*Pongamia pinnata(L.)*Plant fruit

*Pongamia pinnata(L.)*Plant seed

Antihelminthic activity

The antihelmintic activity of the methanolic extract of the seeds needed less time to cause the paralysis and death of Indian adult earthworm *Pherentima posthuman*, than the extracts of leaf, wood, bark, and pericarp of the fruit (Nirmal et al., 2007).

Anti-oxidant activity

Pongamia pinnata leaf extracts show circulatory lipid peroxidation and antioxidant activity. It has been evaluated in ammonium chloride-induced hyper ammonium rats. That enhanced lipid peroxidation in the circulation of ammonium chloride-treated rats, resulting ina significant decrease in the levels of vitamin A, C, E which further reduces catalase glutathione, glutathione peroxides and superoxide dismutase (Essa and Subrahmanian.2006).

Antibacterial

In a study for antibacterial activity against Staphylococcus aureus, an ethanolic extract of *Pongami pinnata* showed to be more effective than aqueous and methanolic extracts. (see constituents above) (Panigrahi et al., 2016)Study of seed extracts showed good bactericidal activity against selected Hospitalized pathogens with maximum activity exhibited on Pseudomonas aeruginosa with inhibition zone of 20 mm by methanol extract and 18.5 mm by ethanol extract in comparison to Ceftazidime. (Rani et al.,2013)

Anti-plasmodial Activity

It has been reported that *Pongamia pinnata* is one the plant, which shows antiplasmodial activity against *plasmodium falciparum*

Anti-ulcer Activity

The methanolic extract of *Pongamia pinnata* roots showed significant protection against aspirin and has a tendency to decrease acetic acid-induced ulcer after 10-days treatment. Having augmentation of mucosal defensive factors like - mucin secretion, life span of mucosal cells, mucosal cell glycoprotein's, cell proliferation and prevention of lipid per oxidation, the extract also shows ulcers protective effect (Prabha et al., 2003).

Anti-diarrhoeal Activity

The anti-microbial effect of crude leaf extract of *Pongamia pinnata* evaluates its effect on production and action of enterotoxins. Its extraction has no anti-bacterial, anti-giardial, and anti-rotaviral activities but reduce the production of cholera toxin and bacterial invasion to epithelial cells. This indicates that the extraction of *Pongamia pinnata* has selective anti-diarrhoeal action with efficacy against cholera (Brijesh et al., 2006).

Anti Lice activity

Growing pattern of pediculocidal drug resistance to words head louse laid the found attraction for research in exploring novel anti lice agent for medicinal plant. In the study, various extracts of *Pongamia Pinnata* leaves tested against the head louse *pediculus humanus capitis*. A filter paper diffusion method was conducted for determining the potential pediculocidal and ovicidal activity of chloroform, P. E, methanol and water extracts of *Pongamia pinnata* leaves. The result revealed that P. E. Extract possess anti and methanol extract showed moderate pediculocidal effects

Neuroprotective activity

The current study found that *Pongamia pinnata* stem bark ethanol extract protects rats from monosodium glutamate-induced neurotoxicity. Intraperitoneal (IP) injections of monosodium glutamate at a rate of 2g/kg body weight (BW)/ day for 7 days induced neurotoxicity. After 1 hour of monosodium glutamate therapy, P.

pinnata stem bark ethanolic fraction (200 and 400 mg/kg) was given orally. Dextromethorphan (30mg/kg orally) was utilized as the ordinary medication for comparison. The ethanolic extract of *Pongamia pinnata* plant stem bark has significant neuroprotective activity in albino rats, according to a report(Swamyet al.,2013)

Anti-inflammatory activity

In acute, subacute and chronic inflammation models, the authors demonstrated the anti-inflammatory efficacy of 70% ethanolic extract of P. pinnataleaves in rats. These findings indicate that the extract of *Pongamia pinnata* leaves has substantial anti-inflammatory activity without ulcerative activity, indicating its potential as an anti-inflammatory agent for use in the treatment of various inflammatory diseases (Srinivasan et al .,2001)

Antiviral activity

White Spot Syndrome Virus (WSSV) is an extremely virulent, contagious, causative agent of the White spot syndrome of shrimp and causes high mortality and affects most of the commercially important cultured marine crustacean species globally . Rameshthangam and Ramasamy evaluated the antiviral activity of bis (2-methylheptyl) phthalate isolated from *Pongamia pinnata* leaves against White Spot Syndrome Virus of Penaeus monodon Fabricius. Oral administration of ethanolic extract and purified compound from the leaves of *Pongamia pinnata* has increased the survival of WSSV infected Penaeus monodon. They fed the pelletized feed impregnated with ethanolic extract of the leaves of *Pongamia pinnata* to shrimp prior and after WSSV infection at 200 and 300 microg/g of body weight of shrimp/day. The survival rate for the WSSV-infected shrimp that were fed with 200 and 300 microg extract/g were 40% and 80%, respectively (Rameshthangam et al., 2007).

Antifilarial potential

Uddin et al. investigated the antifilarial potential of the fruits and leaves extracts of *Pongamia pinnata* on cattle filarial parasite. In their investigation, the aqueous and alcohol extracts of fruits and the alcohol extract of leaves caused an inhibition of spontaneous movements of the whole worm and the nerve-muscle preparation of S. cervi. The concentration required to inhibit the movements of the whole worm preparation was 250µg/mL for aqueous, 120µg/mL for alcohol extract of fruits and 270µg/mL for alcohol extracts of the leaves. The concentrations of *Pongamia pinnata* extracts required to produce an equivalent effect on the nerve-muscle preparation were 25µg/mL, 5µg/mL and 20µg/mL, respectively suggesting a cuticular permeability barrier .

Biodiesel

Pongamia pinnata is a promising energy crop with high seed yield and oil content. *Pongamia pinnata* is a strong candidate to contribute significant amounts of fuel feedstock in biodiesel production. The seeds of *Pongamia pinnata* contain 30-40% oil. However, this naturally occurring oil is rich in triglycerides. Hence, direct use of this oil is unsatisfactory for diesel engines due to it's high viscosity, free fatty acids as well as gum formation following oxidation and polymerization during storage and combustion. Further, carbon deposits and lubricating oil thickening are other issues (Srivastava et al.,2000). Based on the extensive research, it was found that transesterification with methanol method to convert it's oil into fatty acid methyl esters (FAMEs) in the presence of potassium hydroxide (KOH) or 1% H2SO4 is better than pyrolysis and micro-emulsification approaches (De and Bhattacharyya, 1999; Vivek and Gupta, 2004; Karmee and

Chadha, 2005; Meher et al., 2006) and these FAMEs are most suitable for use as a biodiesel as it meets the major specification of biodiesel standards of the USA, Germany and European Standard Organization.

Antimicrobial Textile

Natural antimicrobial agents offer significant potential for improving the safety of clothing, especially for medical and healthcare textiles, due to their non-toxic and eco-friendly properties. Most studies focus on specific agents and their textile applications. However, there is limited research on their mechanisms and limitations (Mondal, 2021). Researchers explored the use of *Pongamia pinnata* phytochemical extracts as antimicrobial coatings for cotton fabrics (Andra et al., 2019). This plant-based solution helps prevent microbial growth in fabrics, reducing the risk of infections. Traditionally, chemical disinfectants were used, but they were found to be toxic to humans, making *Pongamia pinnata* a safer alternative for antimicrobial textile finishes.

Flower source for bees

Pongamia pinnata L. was a perennial flowering plant, growing as an avenue tree for aesthetics. *Pongamia* flowers attracted 21 species of pollinators belonging to orders hymenoptera, diptera, thysanoptera and lepidoptera including aves. Megachilid bees were found to be the most abundant and constituted more than 55% of the insects visiting Pongamia flowers . Some of the examples are *Megachile bicolor*, *M. disjuncta*, *M. conjuncta*, *M. hera*, *M. rotandata*, *M. vigilans*, M. amputata and Coelioxys confusus (parasitic megachilid) was observed to be the prominent pollinators along with that *Apidae bees*, *Apis dorsata*, *A. mellifera*, *A. cerana*, *Xylocopa latipes*, *Pithites smargdula* and one species each of Halictidae *(Nomia iridipennis),* vespidae, thripidae, syrphidae, muscidae, danaidae, lycaenidae, hespiridae and nectarinidae for nectar and pollen reward (Shankar et. al., 2017) .

Nitrogen Fixing

Nodulation is reported in pongam. In nurseries and fields the presence of nodules on uninoculated pongam seedlings is common. Therefore, this species may not be specific in its *Rhizobium* strain requirement. It nodulates and fixes atmospheric nitrogen with *Rhizobium* of the cow pea group.

Folkloric

1. In the Philippines, decoction of leaves given to children for bronchitis and cough.Juice of leaves used for itches and herpes.
2. In the Island of Guimaras, bark used by the natives as abortifacient.
3. Decoction of leaves used for a variety of gastric maladies (tympanism, dyspepsia, diarrhea).
4. Decoction of leaves used as bath for rheumatic joints.
5. Juice of stems, leaves, and roots for painful joints.
6. Juice of roots used for cleaning foul ulcers and closing fistulous sores.
7. For hemorrhoids, poultice of finely pounded leaves, rolled into an elongated mass, insert into rectum as a suppository, at bedtime.
8. For skin diseases, roasted seeds are pounded and applied over affected areas.
9. For skin ulcers, leaves of crushed roots or leaves are applied over affected areas.
10. Mixture of oil and zinc oxide used for eczema.
11. In Tanjore, juice of roots mixed with coconut milk and lime water used as a remedy for gonorrhea.
12. Oil also used for pityriasis versicolor and other fungal skin problems.
13. Seed oil used to treat scabies, herpes and rheumatism.

14. Poultice of leaves used for wounds infested with maggots.
15. Juice of roots with coconut milk used for treatment of gonorrhea.
16. Flowers used for diabetes.
17. Used to relieve vaginal itching.
18. Bark yields a black gum used for treating wounds from poisonous fish.
19. In India, fruits and sprouts used for abdominal tumors, bronchitis, chronic fevers, whooping cough; young shoots used for rheumatism. Seed oil used in scabies, leprosy, hemorrhoids, ulcers, liver pain and lumbago.
20. In Sri Lanka, seeds used for keloid tumors. Decoction of leaves used for pain.
21. In Vietnam, plant derived powder used for tumors.
22. Oil used as liniment for rheumatism.
23. Leaf juice used for cold, cough, diarrhea, dyspepsia, flatulence, gonorrhea and leprosy.
24. Young leaves applied to bleeding hemorrhoids.
25. Bark used internally for bleeding piles.
26. Powdered seeds, after decortication, used as specific for whooping cough; also used as febrifuge and tonic in asthenic and debilitating conditions.
27. Roots used for cleaning gums, teeth and ulcers.

Others

1. Oil: Seed oil used as illuminant and in the manufacture of soaps and candles.
2. Rope: Bark used for making strings and rope.
3. Fish poison: Roots and seeds are used to poison fish in Australia and Madoera.
4. Repellent: Dried leaves used in stored grains to repel insects.
5. Twigs used as chewstick for cleaning teeth.
6. Dye: Ash of wood used for dyeing.

Conclution

This plant is highly significant due to its medicinal properties, which include antioxidant, antibacterial, anti-plasmodial, anti-cancer, anti-diarrheal, anti-inflammatory, and anti-filarial effects, as well as lice-killing capabilities. Furthermore, oil extracted from its seeds can be used to produce biodiesel, serving as a fuel source for the future. It provides nectar to various organisms and plays a vital role in the ecosystem. It should be planted in gardens for aesthetic appeal and along highways. It also holds great importance in the textile industry. By planting this species extensively, we can beautify our environment and help create a pollution-free atmosphere; it should be cultivated on barren lands to transform them into fertile soil, particularly in vacant areas where no vegetation currently exists.

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