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Review Article

A Review on *Pongamia pinnata* (L.): Traditional Uses, Phytochemistry and Pharmacological Properties

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Abstract

Pongamia pinnata (L.) Pierre is one of many plants with different medicinal properties where all its components have been used in the treatment and prevention of many forms of ailments in many countries as traditional medicine. The plant extract shows anti-diarrhoeal, anti-fungal, anti-plasmodial, anti-ulcer, anti-inflammatory, anti-nociceptive, anti-hyperglycaemic, anti-hyperammonic, anti-lipoxidative, anti-oxidant and analgesic activities. For gums, teeth and ulcers, roots are used for cleaning. For bleeding piles, bark is used internally. Traditionally, different parts of the P. pinnata plant are said to be used to treat bronchitis, whooping cough, rheumatism, diarrhea, dyspepsia, flatulence, gonorrhea and leprosy, to name a few. Oil is a source of biodiesel, an alternative, sustainable, nutritious and non-pollutant. The present Knowledge of traditional uses, phytochemistry and pharmacological activities according to parts of the Pongamia pinnata plant is discussed in this study.

Keywords: Fabaceae, Pongamia pinnata, Phytochemistry, Pharmacological properties.

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Introduction:

Pongamia pinnata (L.) Pierre belongs to the Fabaceae family, a medium-sized perennial tree commonly known in Hindi as Karanja and in English as Indian beech. In India, Australia Bangladesh, and China, it is widely distributed. *Pongamia pinnata* has been documented in a number of traditional medicinal systems for the cure of various human diseases and foods. It includes alkaloids, flavonoids, tannins, hormones, glycosides, karangin, glabrin, kanugin, and fixed oils, as well as other phytoconstituents. Historically, *P. pinnata* has been used as a folk medicinal plant, mostly in the Indian medicine systems of Ayurveda and Siddha. The anti-inflammatory, anti-nonciceptive, antioxidant, anti-diarrhoeal, anti-fungal, anti-plasmodial, anti-ulcer, anti-hyperglycaemic, anti-lipoxidative, anti-hyperammonic and analgesic functions are available in plant extracts. The tree is known for its multipurpose advantages and as a potential biodiesel source. On average, the seeds are stated to contain around 28-34% oil with a high percentage of polyunsaturated fatty acids.[1,2,3]

Synonyms: [1,4]

Pongamia pinnata is sometimes referred to by different synonyms, such as

- Millettia pinnata (L.) Panigrahi
- Derris indica (Lam.)
- Pongamia glabra Vent.
- Pongamia pinnata Merr.
- Bennett Millettia novo-guineensis Kane. & Hat

Taxonomical Classification of *Pongamia pinnata* (L.) [2]

Kingdom - Plantae
Subkingdom - Tracheobionta
Super division - Spermatophyta
Division - Magnoliophyta
Class - Magnoliopsida
Subclass - Rosidae
Order - Fabales
Family - Fabaceae
Genus - Pongamia
Species - Pinnata

Botanical description [1]

Pongamia pinnata is a fast-growing tree that ranges 40 feet in height & spreads, creating a wide-ranging, spreading canopy that casts moderate shade, according to Allen and

Allen (1981). All of this plant's evocative botanical characters are listed and its vernacular names and synonyms are given in Table 1.

Plant type: -

A tree of medium height, evergreen, annual and deciduous.

Height: Thirty-five to fourty feet
Texture: Medium
Growth rate: Fast
Chromosome number: 22

Growing requirements: -

Light requirement: tree raises in full sun.

Soil tolerances: clay, loam, sandy, slightly alkaline, acidic, well-drained.

Drought tolerance: high Vaporizer

Salt tolerance: moderate

Winter interest: no special winter

Root: - Taproot is thick and long, lateral roots are numerous and well developed.

Leaf: - Odd pinnate compound, alternate, 2 to 4 inches, evergreen, hairless.

Flower: - Lavender, violet, white, 2-4 together, pea-shaped, short-stalked, 15-18mm long.

Pods: - Smooth, brown, thick-walled, rough, indehiscent, 1-2 grainy, 3-6cm long and 2-3cm tall.

Seed: - Ovoid or elliptical, compressed, been-like, 10-15 mm long, dark brown, oily.

Bark: - The inside is thin gray to grayish brown and yellow.

Table 1: Vernacular names of *Pongamia pinnata* (L.) Pierre.

Languages	Vernacular Name
Hindi, Marathi and Guajarati	Karanj, Karanja
Sanskrit	Ghrtakarauja, Karanjaka, Naktahva, Naktamala
English	Indian beech
Telgu	Pungu, Gaanuga
Tamil	Ponga, Pongam
Malayalam	Pungu, punnu
Oriya	Koranjo
Punjabi	Sukhehein, Karanj, Paphri
Assam	Karchuw
Bengali	Dahara Karanja, Karanja, Natakaranja
Kannada	Honge, Hulagilu

(A)

(B)

(C)

(D)

Figure 1: *Pongamia pinnata*: A) The whole plant B) Leaves C) Fruits D) Seeds.

Medicinal uses according to the parts of *Pongamia pinnata* plant [2]

Sr. No	Plant part used	Activity Done
1.	**Leaves**	Anti-diarrhoeal action Anti-lice Activity Dyspepsia Anti-viral activity Anti-filarial activity Anti-microbial activity Gonorrhea Leprosy Anti-inflammatory activity Anti-pyretic action
2.	**Flowers**	Anti-hyperammonemic activity Anti-oxidant activity Bleeding pile Anti-hyperglycemic activity Anti-lipidperoxidative activity
3.	**Oil**	Leprosy Ulcers Liver pain Piles Rheumatism arthritis Scabies Chronic fever Whooping cough Anti-fungal activity Anti-bacterial activity Anti helmintic
4.	**Fruits**	Female genital tract Leprosy Tumour Piles Ulcers Anti-filarial activity Abdominal tumors
5.	**Seeds**	Bronchitis Whooping cough Inflammations Nootropic activity Rheumatic arthritis. Hypertension Skin ailments Chronic fevers Hemorrhoids Anemia Pectoral diseases
6.	**Roots**	Anti-Nociceptive activity Anti-Helmintic activity Vaginal infections Skin diseases Gonorrhea
7.	**Stem**	Anti-pyretic activity CNS sedative
8.	**Bark**	Swelling of the spleen Mental disorder Bleeding piles Beriberi Cough and cold

Phyto-chemistry: [5]

a) Contents of Leaves:

- Alkaloid
- Carbohydrates
- Flavonoids- Kaempferol, Quercetin, Rutin [1]
- Tannin
- Saponin
- Phytosterol

b) Contents of seeds

Components	Percentage
Protein	17.4%
Fatty oil	27.5%
Crude fiber	7.3%
Starch	6.6%
Moisture	19%
Ash	2.4%

- Karangin
- Kaempferol
- Kanugin
- Kankone
- Alkaloids dimethoxy-kanugin
- Glabrin
- Gamatay
- Glabrosaphonin
- Tannin
- β-sitosterol
- Saponin
- Quercetin
- Pongapin
- Pinnatin
- Pongamol
- Neoglabrin

c) Contents of seed oil:

- Karanjin ($S_{18}H_{22}O_4$)
- Pongamol
- Glabrachalcone
- Kanjone
- Pongapin

d) Content of bark

- Resin
- Contains a bitter alkaloid
- Sugar
- Mucilage

From the stem bark of *P. pinnata* two new compound

- 3-methoxy-(3,4-dihydro 3-hydroxy-4-acetoxy)-2,2-dimethylpyrano-(7,8:5,6)-flavone
- 3-methoxy-(3,4-dihydro 4-hydroxy-3-acetoxy)-2,2-dimethylpyrano-(7,8:5,6)-flavone
- Ovaliflavanone A

- Isolonchocaprin
- Dimethylallylflavonone
- Caryophyllene oxide
- Obovatachalcone

Pharmacological Properties:

- **Anti-inflammatory activity:** In acute, subacute and chronic inflammation models, the authors demonstrated the anti-inflammatory efficacy of 70% ethanolic extract of *P. pinnata* leaves 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.[6]
- **Cardioprotective activity:** The authors investigated the cardioprotective activity of *P. pinnata* in diabetic rats with streptozotocin-nicotinamide. The authors researched the effect of *Pongamia pinnata* stem bark petroleum ether extract on cardiomyopathy in diabetic rats.[7]
- **Antinociceptive and Antipyretic Activity:** *Pongamia pinnata* leaves have antinociceptive and antipyretic behaviors. In this study, the authors tested the antinociceptive efficacy of the 70% ethanolic extract of *P. pinnata* leaves in various pain models in rats and mice. Furthermore, in Brewer's yeast-induced pyrexia in rats, *Pongamia pinnata* leaves extract was also evaluated for its antipyretic effect. The findings showed that the extract of *Pongamia pinnata* leaves has marked antinociceptive and antipyretic activity.[8]
- **Wound healing, Antimicrobial, Antioxidant Activity:** In wistar rats, the authors assessed the wound healing, antioxidant ability and anti-microbial of *Pongamia Pinnata*. Increased wound contraction and tensile strength, increased hydroxyproline and hexosamine content, antioxidant action and moderate antimicrobial activity are shown in methanol extracts of *P. pinnata* leaf to promote early wound healing demonstrated by *P. pinnata*. [9]
- **Anticonvulsant activity:** The authors tested the anticonvulsant efficacy in laboratory animals of the petroleum ether extract of *P. Pinnata* stem bark and its fractions. *P. pinnata* stem bark-petroleum ether extract has been tested against convulsions caused in mice by pentylenetetrazol (PTZ), picrotoxin (PTX), maximal electroshock (MES), strychnine (STY) and isoniazid (INH). The outcome showed that *P. pinnata* stem bark-petroleum ether extract had a strong anticonvulsant effect.[10]
- **Antiviral activity:** Antiviral activity was demonstrated by the crude aqueous seed extract. It complete inhibited the growth of type 1(HSV-1) and (HSV-2) herpes simplex virus at 1 and 20 mg/ml (w/v) concentrations, respectively, and showed complete absence of cytopathic influence. The crude extract of dried leaves showed no action against the rota virus. The safety effect of Karanja seed extract 24 was demonstrated by acute and chronic toxicological studies in Swiss albino rats. The antiviral activity of bis (2-methylheptyl) phthalate secluded from *P.pinnata* leaves against White Spot Syndrome Virus (WSSV) of Penaeus monodon Fabricius was evaluated.[11]
- **Anti-diabetic activity:** Oral administration of ethanolic extract of *P. pinnata* flowers (300 mg/kg bw) showed substantial anti-hyperglycemic effects, which significantly decreased blood glucose levels to a degree close to that of the reference drug glibenclamide (600 µg/kg bw) in diabetic alloxane-induced rats (Punitha and Manoharan, 2006). The aqueous extract of the flower also displayed strong antihyperglycemic activity and raised the level of plasma insulin significantly. In alloxan-induced diabetic rats, the extract also regulated the actions of glucose-6-phosphatase and hexokinase.[12]
- **Antibacterial Activity:** *Pongamia pinnata* leaf chloroform extract demonstrated higher antibacterial action against E-coli, Staphylococcus aureus and Pseudomonas aeruginosa, while acetone extract was more active than normal against E-coli and Pseudomonas aeruginosa (Gentamycin). Compared to the standard, the petroleum ether extract didn't demonstrate significant antibacterial activity.[13]
- **Antidiarrhoeal Activity:** The antimicrobial effect of the crude decoction of dried *Pongamia pinnata* leaves was assessed to determine this behavior. Enterococcus (cholera toxin, Escherichia coli labile toxin, stable toxin) and enteropathogenic E-coli adherence and invasion of enteroinvasive E-coli and Shigella flex epithelial cells were also evaluated for their effects on development and action. This research shows that *Pongamia pinnata* decoction had selective anti-diarrhoeal action against cholera and enteroinvasive bacteria that triggered the episode of bloody diarrhoea.[14]
- **Antiprotozoal activity**: The plant had been documented against *Plasmodium falciparum* for its anti-plasmodial activity.[15]
- **Anti-Ulcer activity:** The methanol root extract of *P. pinnata* has been reported to provide substantial defense against aspirin-induced mucosal damage and has a potential to minimize acetic acid-induced ulcers after 10 days of treatment. With the cessation of mucosal defense factors such as mucin secretion, mucosal cell glycoproteins, life span of mucosal cells, cell proliferation and lipid peroxidation prevention, the extract showed ulcer protective effects.[16]
- **Anti-hyperglycemic & anti-lipid peroxidative activity:** Orally administration of ethanolic extract of *P. pinnata* flowers has been reported to show important antihyperglycemic and anti-lipid peroxidative effects and improvement of the antioxidant protection system in diabetic rats induced by alloxan. Oral administration of the extract of the flower (300mg/kg bw) exhibited antihyperglycemic action which considerably reduce the blood glucose concentration in a similar extent to that of the reference drug glibenclamide (600mg/kg bw) in alloxan -induced diabetic rats. The findings indicated that treatment with *Pongamia pinnata* extract could be used in diabetic patients as a safe alternative to anti-hyperglycaemic medications.[17,18]
- **Neuroprotective Activity:** The current study showed a neuroprotective impact of *P. pinnata* stem bark ethanol extract on monosodium glutamate-induced neurotoxicity in rats. Neurotoxicity was caused by intraperitoneal route injection of 2 g/kg body weight per day for 7 days of monosodium glutamate. *P. pinnata* stem bark ethanol extract (200 and 400 mg/kg) was orally administered after 1 h of

monosodium glutamate therapy. As the normal drug for comparison, dextromethorphan (30 mg/kg, p.o.) was used. The study indicates that stem bark of *Pongamia* plant ethanolic extract has important neuroprotective activity in albino rats.[19]

- **Anti-Lice activity:** In discovering novel anti lice agent for medicinal plants, the growing trend of pediculoicidal drug resistance to the terms head louse laid the found attraction for research. Different extracts of *P. Pinnata* leaves in the sample Checked against head louse pediculus humanus capitis. The outcome indicated that P. E. Extract demonstrated mild pediculocidal effects with anti and methanol extract.[20,21]

Conclusion:

The present review shows that the significance of *Pongamia pinnata* (karanja) as an essential medicinal plant was defined by the plant parts for its pharmacological properties and its indications. In several countries, particularly in India, *Pongamia pinnata* (Karanja) has been extensively used as a traditional medicine. In the traditional systems of medicines, such as Ayurveda and Unani, the *Pongamia pinnata* plant is used for anti-inflammatory, cardioprotective, anti-playsmodial, anti-nociceptive, anti-diarrhoeal, anti-ulcer, anti-hyperglycaemic, anti-hyperammonic and antioxidant, antibacterial, antiviral, anticonvulsant activity.

References:

1. Satish A. Bhalerao, Amit S. Sharma. Ethnopharmacology, Phytochemistry and Pharmacological Evaluation of Pongamia pinnata (L.) Pierre. International Journal of Current Research in Biosciences and Plant Biology.2014; 1(3):50-60.
2. Battu Ganga Rao, Seerapu Jayasree Reddy, Devarakonda Ramadevi, Battu Heera, Phytochemical and Pharmacological studies on Pongamia pinnata. Indian Journal of Research.2018; 7(2):489-492.
3. Meera B., Kumar S., Kalidhar S.B., 2003. A review of the chemistry and biological activity of Pongamia pinnata. J. Med. Aromatic. Plant Sci. 2003; 25:441-65.
4. Sowjanya P, Srinivasa Babu P, Lakshmi DN, Navyasri N, Harshini Y, Vyshnavi J, Prasanth M, A phyto pharmacological review on a versatile medicinal plant: Pongamia pinnata (L.) pierre. Journal of Pharmacognosy and Phytochemistry.2018; 7(4):459-463.
5. Bholane A, Hiremath VV, Acritical review on Karanja (pongamia pinnata) & its medicinal properties. Journal of Ayurveda and integrated medical sciences.2020; 5(2):194-202.
6. Srinivasan K, Muruganandan S, Lal J, Chandra S, Tandan SK, Ravi Prakash V. Evaluation of anti-inflammatory activity of Pongamia pinnata leaves in rats. Journal of Ethnopharmacology.2001; 78:151–157.
7. Badole SL, Chaudhari SM, Jangam GB, Kandhare AD, Bodhankar SL. Cardioprotective Activity of Pongamia pinnata in Streptozotocin-Nicotinamide Induced Diabetic Rats. BioMed Research International. 2015; 1-8.
8. Srinivasan K, Muruganandan S, Lal J, Chandra S, Tandan SK, Ravi Prakash V, Kumar D. Antinociceptive and Antipyretic Activities of Pongamia pinnata Leaves. Phytotherapy Research.2003; 17:259–264.
9. Dwivedi D, Dwivedi M, Malviya S, Singh V. Evaluation of wound healing, anti-microbial and antioxidant potential of Pongamia pinnata in wistar rats. Journal of Traditional and Complementary Medicine.2016; 7(2017):79-85.
10. Ramdhave AS, Badole SL, Bodhankar SL. Anticonvulsant activity of stem bark of *Pongamia pinnata.* Biomedicine & Aging Pathology. 2011; 1: 147–157.
11. P. Rameshthangam, P. Ramasamy. Antiviral activity of bis(2-methylheptyl) phthalate isolated from Pongamia pinnata leaves against White Spot Syndrome Virus of Penaeus monodon Fabricius. Virus Research.2007; 126:38–44.
12. Punitha, R., Vasudevan, K., Manoharan, S. Effect of Pongamia pinnata flowers on blood glucose and oxidative stress in alloxan induced diabetic rats. Indian Journal of Pharmacology 2006; 38:62–63.
13. L.M.R. Al Muqarrabun, N. Ahmat, S.A.S. Ruzaina, N.H. Ismail, I. Sahidin, Medicinal uses, phytochemistry and pharmacology of Pongamia pinnata (L.) Pierre: A review. Journal of Ethnopharmacology.2013; 395–420.
14. Brijesh S, Daswani PG, Tetali P, Rojatkar SR, Anita NH, Birdi TJ. Studies on Pongamia pinnata (L.) Pierre leaves: understanding the mechanism(s) of action in infectious diarrhea. Journal of Zhejiang University SCIENCE B. 2006; 7:665-74.
15. Simonsen HT, Nordskjold JB, Smitt UW, Nyman U, Palpu P, Joshi P et al. In vitro screening of Indian medicinal plants for antiplasmodial activity. Journal of Ethnopharmacology. 2001; 74:195-204
16. Prabha T, Dora M, Priyambada S. Evaluation of Pongamia pinnata root extract on gastric ulcers and mucosal offensive and defensive factors in rats. Indian Journal Experimental Biology. 2003; 41:304-10.
17. Punitha R, Manoharan S. Antihyperglycaemic and antilipidperoxidative effects of Pongamia pinnata (Linn.) Pierrre flowers in alloxan-induced diabetic. J Ethon Pharmacol. 2006; 105:39-46.
18. Kirtikar KR, Basu BD. Indian medicinal Plants I. Lalit Mohan Basu, Allahabad, India, 1993, 830.
19. Viswanatha swamy HM, Patel NL, Gadad PV, Koti C, Patel HM, Thippeswamy C, . Manjula V, Neuroprotective Activity of Pongamia pinnata in Monosodium Glutamate-induced Neurotoxicity in Rats. Indian Journal of Pharmaceutical Sciences. 2013; 75(6):657-663.
20. Mumcuoglu KY. Prevention and treatment of head lice in Children. Prediatr Drugs. 1999; 1:211-218.
21. Yang YC, Lee HS, Clark JM, Ahn YJ. Insecticidal activity of plant essential oil against Pediculus humanus Capitis (Anoplura: Ped; Culidae). J Med Entomol. 2004; 41: 699-704.
22. Rangaswami, S., Seshadri, T.R., 1942. Chemistry of Pongamol. Part I. The Indian Academy of Sciences, India, pp. 417–423.
23. Rao, N.V.S., Rao, J.V., 1941. A note on Glabrin, a new component of the seeds of Pongamia glabra. The Indian Academy and Sciences, India, pp. 123–125.
24. Krishnamurthi A. 1969. The Wealth of India, vol. VIII. Publication and Information Directorate CSIR, New Delhi, India.
25. Natanam R, Kadirvel, R, Chandrasekaran D.,Chemical composition of karanja (Pongamia glabra Vent) (P.Pinnata) kernel and cake as animal feed. Indian J. Anim. Nutr.1989; 6:270-273.
26. Kirtikar KR, Basu BD. Indian medicinal Plants I. Lalit Mohan Basu, Allahabad, India, 1993, 830.