

## Review Article

### **Pongamia pinnata: An Overview on Ethobotany, Phytochemistry and Pharmacological Activities**

**Atul Kumar Gangwar<sup>1</sup>and Ashoke K.Ghosh<sup>2</sup>**

<sup>1</sup>Rakshopal Bahadur College of Pharmacy, Braeilly, (U.P.) - 243001, India.

<sup>2</sup>School of Pharmaceutical Sciences, IFTM University, Moradabad- U.P.

#### \*Corresponding author

**Atul Kumar Gangwar**

Email: [atulgangwar@yahoo.co.in](mailto:atulgangwar@yahoo.co.in)

**Abstract:** *Pongamia pinnata Linn. Pierre* commonly known as ‘Karanj’ belonging to *Leguminosae* family (sub family-*Papilionaceae*) has been used in different system of traditional medicines for the treatment of various diseases. It contains various phytoconstituents belonging to alkaloids, glycosides, flavonoids, fixed oils, and carbohydrates. The roots of *Pongamia pinnata* are good for cleaning foul ulcers, cleaning teeth, strengthening gums and gonorrhoea. The root paste for local application in scrofulous enlargement. The fresh bark of *Pongamia pinnata* is sweet and mucilaginous to taste, soon become bitter and acrid. It is antihelminthic and useful in beri-beri, ophthalmology, dermatopathy, vaginopathy, and ulcers. Leaves of *Pongamia pinnata* are digestive, laxative, anthelmintic and are good for diarrhea, leprosy, dyspepsia and cough. Flowers are useful to quench dipsia in diabetes and for alleviating vata and kapha. The seeds are anthelmintic, bitter, acrid, haematinic and carminative. They are useful in inflammation, chronic fevers, anaemia and hemorrhoids. The oil is antihelminthic, styptic and recommended for ophthalmia, leprosy, ulcers, herpes and lumbago. Its oil is a source of biodiesel.

**Keywords:** Karanj, *Pongamia pinnata*, Anti-inflammatory, Anti-hyperglycaemic, Anti-oxidant, Anti-hyperammonemic, Anti-diarrhoeal Activity, Anti-ulcer

## **INTRODUCTION**

The ‘Pongam Tree’ is known as one of the richest and brightest trees of India. The tree is named as ‘*Pongamia pinnata*’ in science, belonging to *Leguminosae* family (sub family-*Papilionaceae*). In the Tamil, this is generally known as ‘Ponga’, ‘Dalkaramacha’, ‘Pongam’ and ‘Punku’. In both the languages of Hindi and Bengali, the people named it as ‘Karanj’ or ‘Papar’ or ‘Kanji’. It is called ‘Karum Tree’ or ‘Poonga Oil Tree’ in English. The fruits of ‘Pongam Tree’ are some timber-like pods that grow about in length. They are dark grey in colour and get matured just before the next lot of new leaves appears. Each of the seeds of this tree is covered with a strong raft. The raft looks like a rubber ship. The leaves of the ‘Pongam Tree’ have five, seven, or nine oval-shaped leaflets that have pointed tips. The leaves are around 15 cm to 30 cm in the length and each of the leaflets is short stalked. The leaf stems and the flower stems are normally puffy at their bases. It is one of the few ‘Nitrogen Fixing Trees’ producing seeds containing 30-40% oil. It is an

Indo-Malaysian species, a medium-sized evergreen tree, common on alluvial and coastal situations from India to Fiji, from sea level to 1200 m. Now found in Australia, Florida, Hawaii, India, Malaysia, Oceania, Philippines and Seychelles [1].

#### **Vernacular names [2]**

Sanskrit : Ghrtakarauja, Karanjaka, Naktaiva, Naktamala

Bengali : Dahara karanja, Karanja, Natakaranja

Assamese: Korach

Kannada : Honge, Hulagilu

Marathi : Karanja

Gujrati : Kanaji, Kanajo

Punjabi : Karanj

Telugu : Ganuga, Kanugu

Hindi : Karuaini, Dithouri

Oriya : Karanja

Tamil : Pungai, Pongana

Urdu : Karanj

Malayalam: Pungu, Unu, Avittal



Fig- 1 (whole plant)



Fig-2 (plant with stem, fruit & leaves)



Fig-3 (flowers)



Fig-4 (fruits)



Fig-5 (leaves)



Fig-6 (seeds)

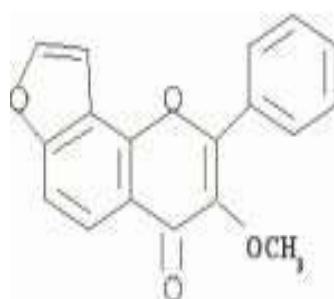
### TRADITIONAL USE

It contains several phytoconstituents belonging to category flavonoids and fixed oils. The fruits and sprouts of *Pongamia pinnata* were used in folk remedies for tumors [3]. Herbal remedies have been recommended in various medical treatises for the cure of different diseases. It has been recognized in different system of traditional medicines for the treatment of different diseases and ailments of human beings [4, 5]. Seed extract of this plant has hypotensive effects and produce uterine contractions. Powdered seed is used in bronchitis, chronic fever, whooping cough and chronic skin diseases and painful rheumatic joints [6]. Seed oil is used in scabies, leprosy, piles, ulcers, chronic fever, lever pain and lumbago. Its oil is a source of biodiesel and it is also used as fuel for cooking and lamps [7]. It has also alternative source of energy, which is renewable, safe and non-pollutant. Leaves are active against *Micrococcus*; their juice is used for cold, cough, diarrhoea, dyspepsia, flatulence, gonorrhoea and leprosy. Roots are used for cleaning gums, teeth and ulcers. Bark is used internally for bleeding piles. Juices from the plant as well as oil are antiseptic. In the

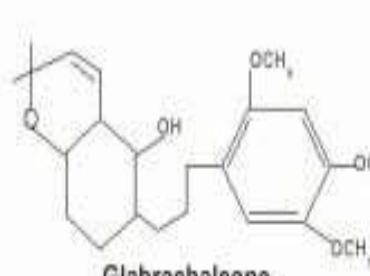
traditional system of medicines, such as Ayurveda and Unani, the *Pongamia pinnata* plant is used for anti-inflammatory, anti-plasmodial, anti-nociceptive, anti-hyperglycaemics, anti-lipidoxidative, antidiarrhoeal, anti-ulcer, anti-hyperammonic, CNS depressant activity and antioxidant.

### PHYTOCHEMISTRY

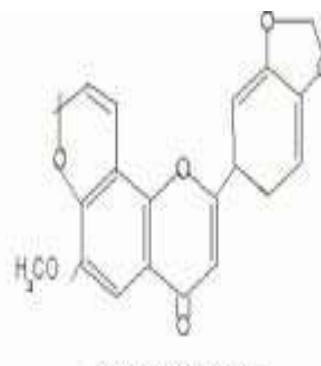
*Pongamia pinnata* seeds contain many compounds like fatty acids, sterols and their derivatives with the help of physiochemical methods and spectroscopic techniques. The metabolites, betasitosteryl acetate and galactoside, stigma sterol. The saturated and unsaturated fatty acids (two monoenoic, one dienoic and two trienoic) were present in exactly the same amount. Oleic acid occurred in highest amount. The stearic (about 30%) and palmitic acids (about 19%) were present in the seeds. Karangin, pongamol, pongagalabrone, and pongapin, pinnatin and kanjone have been isolated from seeds. Immature seeds contain a flavone derivative 'pongol'. The other flavonoid isolated from the seeds includes 'Glabrachalcone isopongachromene'.



Karangin



Glabrachalcone



Isopongachromene

The leaves and stem of the plant consist of several flavone and chalcone derivatives such as Pongone, Galbone, Pongalabol, Pongagallone A and B [8]. Chemical investigation of stems of the mangrove plant, *Pongamia pinnata*, resulted in isolation and characterization of five structurally unusual flavonoids metabolites. Their structures were determined on the basis of spectroscopic analyses and by comparision of their spectroscopy data with those of related compounds reported in the literature. Pongamones A-E was assayed against DHBV RCs DNAP and HIV-1 RT in vitro. A

possible biogenetic pathway of the isolated compounds is also proposed [9].

Further investigation of the flavonoid constituents of *P. Pinnata* from Japan resulted in the isolation of 18 flavonoid compounds including nine new ones, Pongamones III-XI, from its root bark. The new structures were determined to be (2S)-3', 4'-dimethoxy-6'',6''-dimethylpyranopyrone [2'',3'',7,8]-flavanone (III), (2S)-6,3',4'-3',4'-trimethoxy-6'',6''-dimethylpyranopyrone [2'',3'',7,8]-flavanone (IV), (2S)-7-methoxy-6-O-y, y-

dimethylallyl-3', 4'-methylenedioxyflavanone (V), 2'-hydroxy-3,4,5'-trimethoxy-6'',6''-dimethylpyrano[2'',3'':4'3'] chalcone (VI), 2',4'-dimethoxy-3, 4-methylenedioxy dioxodihydrochalcone (VII), 2',5',Beta-trimethoxy-3,4-methylenedioxy-6'',6''-dimethylpyrano[2'',3'':4'3'] dihydrochalcone (VIII), 2,Beta-dimethoxy-3,4-methylenedioxy-furano[2'',3'':4'3']-dihydrochalcone (IX), Beta-hydroxy-2',4'6'-trimethoxy-3,4-methylenedioxychalcone (X) and 3-methoxy-furane[2',3'':7,6] favpme(XI), respectively ,by means of spectral analysis and synthesis [10]. *Pongamia pinnata* fruits afforded three new furanoflavonoid glucosides, pongamosides-A-C and a new flavonol glucoside, pongamoside D. The structures of these compounds were established on the basis of spectroscopic studies. This is the first time that furanoflavone glucosides have been found as naturally occurring compounds.

## PHARMACOLOGICAL ACTIVITY

### Anti-ulcer Activity

It has been reported that methanolic extract of *Pongamia pinnata* roots showed significantly protection against aspirin [11] 4 h PL, but not against ethanol-induced ulceration. It showed tendency to decrease acetic acid-induced [12] ulcer after 10-day treatment. Ulcer protective effect of PPRM was due to augmentation of mucosal cells, mucosal cell glycoproteins, cell proliferation and prevention of lipid per oxidation rather than on the offensive acid-pepsin secretion[13].

### Anti-diarrhoeal Activity

It has been evaluated that anti-microbial effect of crude decoction of dried leaves of *Pongamia pinnata* [14] and also evaluated its effect on production and action of enterotoxins (cholera toxin, *Escherichia coli* labile toxin and *E.coli* stable toxin) and adherence of enteropathogenic *E.coli* and invasion of enteroinvasive *E.coli* and *Shigella flexneri* to epithelial cells. The decoction had no anit-bacterial, anti-giardial, and anti-rotaviral activites, but reduced production of cholera toxin and bacterial invasim to epithelial cells. The observed result indicated that decoction of *Pongamia pinnata* has selective anti-diarrhoeal action with efficacy against cholera and enteroinvavaisve bacterial strains causing bloody diarrhoeal episode [15].

### Anti-oxidant and Anti-hyperammonemic

It has been observed that effect of *Pongamia pinnata* leaf extract on circulatory lipid peroxidation and antioxidant status was evaluated in ammonium chloride-induced hyperammonium [16, 17] rats. It enhanced lipid peroxidation in the circulation of ammonium chloride-treated rats was accompanied by a significant decrease in the levels of Vitamin- A, Vitamin-C, Vitamin-E reduced glutathione, glutathione preoxidase, superoxide dismutase and catalase. It showed that PPET modulates by reversing the oxidant-

antioxidant imbalance during ammonium chloride-induced hyperammonemia and this could be due to its anti-hyperammonemic effect by means of detoxifying excess ammonia, urea and creatinine and antioxidant property [18].

### Anti-plasmodial Activity

It has been reported that *Pongamia pinnata* is one the plant, which shows antiplasmodial activity against plasmodium falciparum [19].

### Anti-hyperglycaemic and Anti-lipidperoxidative Activity

It has been reported that oral administration of ethanolic extract of *Pongamia pinnata* flower shows significant anti-hyperglycaemic and anti-lipidperoxidative effect and enhancement in antioxidant defense system in alloxan-induced diabetic. These results suggested that the treatment of *Pongamia pinnata* extract could be used as a safe alternative anti-hyperglycaemic drug for diabetic patients [20].

### Anti-inflammatory Activity

It has been reported that the 70% ethanolic extract of *Pongamia pinnata* leaves has potent anti-inflammatory activity against different phases (acute, subacute and chronic) of inflammation without side effect on gastric mucosa [21, 22]. They also observed significant anti-pyretic action of the extract against Brewer's yeast-induced pyrexia [23, 24, 25].

### Anti-viral activity

Viral inhibition studies with the extract of *Pongamia pinnata* seeds against HSV-1 and HSV-2 were evaluated in vitro. The most striking observation was the total inhibition of growth of HSV-1 and HSV-2 at concentrations of 1 mg/ml and 20 mg/ml w/v respectively, whereas even at the highest concentrations the extract was not toxic for Vero cells. Acute and Chronic toxicological studies conducted in Swiss albino rats showed the safety of the *Pongamia pinnata* seed extract [26].

### Anti-bacterial Activity

It is reported that the leaves of *Pongamia pinnata* show antibacterial effect. It is clear that the extracts have great potential as antibacterial compounds against enteric pathogens and that they can be used in the treatment of enteric infectious. This plant can be used to discover bioactive natural products that may serve as leads for the development of new pharmaceuticals that address hither to unmet therapeutic needs. It is hoped that this study would lead to the establishment of some compounds that used to formulate new and more potent antimicrobial drugs of natural origin [27, 28].

### Anti-lice Activity

Growing patterns of pediculocidal drug resistance towards head louse laid the foundation for

research in exploring novel anti-lice [29, 30] agents from medicinal plants. In the study, various extracts of *Pongamia pinnata* leaves tested against the head louse *Pediculus Humanus Capitis* [31]. A filter paper diffusion method was conducted for determining the potential pediculocidal and ovicidal activity of chloroform, petroleum ether, methanol and water extracts of *Pongamia pinnata* leaves. The findings revealed that petroleum ether extracts possess excellent anti-lice activity with values ranging between 50.3% and 100% where as chloroform and methanol extracts showed moderate pediculocidal effects. The chloroform and methanol extracts were also successful in inhibiting nymph emergence and the petroleum ether extracts was the most effective with a complete inhibition of emergence. Water extract was devoid of both pediculocidal and ovicidal activities. All the results were well comparable with the benzoyl benzoate (25% w/v).

## CONCLUSION

In traditional system of Ayurvedic medicine *Pongamia pinnata* has been widely used as curative agents for variety of ailments. Concentrated fruits or seeds extract can be found in various herbal preparations are widely available in market today. *Pongamia pinnata* preparation oil is widely available and employed by practitioner of natural health for treatment of rheumatism. In the traditional systems of medicines, such as Ayurveda and Unani, The *Pongamia pinnata* plant is used for Anti-inflammatory, Anti-plasmodial, Anti-nociceptive, Anti-hyperglycaemic, Anti-lipidperoxidative, Anti-diarrhoeal, Anti-ulcer, Anti-hyperammonic and Anti-oxidant. Its oil is a source of biodiesel. It has also alternative source of energy, which is renewable, safe and non-pollutant.

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