



ORIGINAL RESEARCH PAPER

Pharmacology

PHYTOCHEMICAL AND PHARMACOLOGICAL STUDIES ON PONGAMIA PINNATA

KEY WORDS: *Pongamia*, Hepatoprotective, Fabaceae.

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ABSTRACT
Pongamia pinnata (L.) Pierre belonging to the family Fabaceae is a medium sized evergreen tree popularly known as Karanja in Hindi, Indian beech in English. It is widely distributed in India, Bangladesh, China and Australia. *P. pinnata* has been recognized in different system of traditional medicines for the treatment of different disease and ailments of human beings. It contains several phytoconstituents such as alkaloids, tannins, steroids, glycosides, demethoxy-kanugin, glabrin, kanugin, karangin, flavonoids and fixed oils. Extract of the plant posses significant anti-diarrhoeal, anti-fungul, anti-plasmodial, anti-ulcerogenic, anti-inflammatory, anti-nonceptive, anti-hyperglycaemics, anti -lipoxidative, anti-hyperammonic, anti-oxidant and analgesic activities. Roots are used for cleaning gums, teeth and ulcers. Bark is used internally for bleeding piles. Different parts of this plant are traditionally claimed to be used for the treatment of bronchitis, whooping cough, rheumatism, diarrhea, dyspepsia, flatulence, gonorrhoea and leprosy to list a few. Its oil is a source of biodiesel-an alternative source of energy, renewable, safe and non-pollutant.^[1] Hence, this study was intended to investigate the *in vitro* hepato-protective effects of the stem-bark of *Pongamia pinnata*.

Introduction

Pongamia pinnata (L.) Pierre is a medium sized glabrous tree. *P. pinnata* also called as Derris indica, is a monotypic genus and grows abundantly along the coasts and riverbanks in Myanmar. The tree is known for its multipurpose benefits and as a potential source of biodiesel^[2]. The seeds are reported to contain on average about 28-34% oil with high percentage of polyunsaturated fatty acids.^[3]

Description Of Family Fabaceae

The **Fabaceae** or **Leguminosae**, commonly known as the **legume, pea, or bean family**, are a large and economically important family of flowering plants. It includes trees, shrubs, and herbaceous plants perennials or annuals, which are easily recognized by their fruit (legume) and their compound, stipulated leaves. The group is widely distributed and is the third-largest land plant family in terms of number of species, behind only the Orchidaceae and Asteraceae, with 630 genera and over 18,860 species.^{[4][6]} About 18,000 legume species are known, amounting to about 7% of flowering plant species.^{[4][5]} Fabaceae is the most common family found in tropical rain forests and in dry forests in the Americas and Africa.^[7] The Leguminosae have a wide variety of growth forms including trees, shrubs or herbaceous plants or even vines or lianas. The herbaceous plants can be annuals, biennials or perennials, without basal or terminal leaf aggregations. They are upright plants, epiphytes or vines. The latter support themselves by means of shoots that twist around a support or through cauline or foliar tendrils. Plants can be heliophytes, mesophytes or xerophytes.^{[8][4]}

Taxonomical Classification Of *Pongamia pinnata* (L.) Pierre:^[9]

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

Vernacular names and synonyms of *Pongamia pinnata* (L.) Pierre:^[1]

| Languages | Vernacular Names |
|-----------------------------|---|
| Hindi, Marathi and Gujarati | Karanj, Karanja |
| Sanskrit | Ghrtakarauja, Karanjaka, Naktahva, Naktamala |
| English | Indian beech |
| Telugu | Pungu, Gaanuga |
| Tamil | Ponga, Pongam |
| Malayalam | Pungu, Punnu |
| Oriya | Koranjjo |
| Punjabi | Sukhehein, Karanj, Paphri |
| Assam | Karchuw |
| Bengali | Dahara karanja, Karanja, Natakaranja |
| Kannada | Honge, Hulagilu |
| Synonyms | <i>Derris indica</i> (Lam.) Bennett <i>Millettia</i> novo-Guineensis Kane. & Hat. <i>Pongamia glabra</i> Vent. <i>Pongamia pinnata</i> Merr |

Botanical Description of *Pongamia pinnata* (L.) Pierre

A medium sized semi evergreen glabrous tree with a short bole and spreading crown upto 18 m or more in height.^[10] *P. pinnata* is a fast-growing tree which reaches 40 feet in height and spread, forming a broad, spreading canopy casting moderate shade.^[1]

Root:

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

Leaf:

very often mottled with dark brown dots, specks, lines or streak; leaves compound, leaflets 5-7 ovate, acuminate or elliptic; fruits thick, woody, smooth, compressed, with a short curved beak. Alternate, odd pinnately compound, 2 to 4 inches, evergreen, hairless.

Flower:

Flowers lilac or pinkish white, Lavender, fragrant, in axillary racemes 2-4 together, short-stalked, pea shaped, 15-18mm long.

Pods :

3-6cm long and 2-3cm wide, smooth, brown, thick-walled, hard, indehiscent, 1-2 seeded.

Seed:

Compressed ovoid or elliptical, been-like, 10-15cm long, dark brown, oily. Seeds 1 or 2 per pod, reniform to nearly round, smooth or wrinkled, testa reddish brown leathery.

Bark:

Thin gray to grayish brown and yellow on the inside.

Traditional Uses

- The seed-oil of *Pongamia pinnata* possesses medicinal properties and used in itches, abscess and other skin diseases. [11]
- Flowers are prescribed for glycosuria and as a remedy for diabetes. [12]
- The bark is used internally for bleeding piles, beriberi [13] and diabetes [14] and anti- hepato-protective activity as an antimicrobial. [15]
- Karanja seed is used as a medicinal plant, particularly with the Ayurvedic and Sidda medicine systems of India. Crude seed extraction completely inhibit the growth of herpes simplex virus type 1 and type 2 in Vero cells and also possesses hypoglycemic, anti-oxidative, anti-ulcerogenic, anti-inflammatory and analgesic properties. [16]
- Different parts of the plant have been used in traditional medicines for bronchitis, whooping cough, rheumatic and to quench dipsia in diabetes. [17]
- The leaves are hot, digestive, laxative, anti-helminthic and cure piles,wounds and other inflammations. A hot infusion of leaves is used as a medicated bath for relieving rheumatic pains and for cleaning ulcers in gonorrhea and scrofulous enlargement. [18],[19]
- Different extracts of leaves, roots and seeds are used to treat infectious diseases such as leucoderma, leprosy, lumbago, muscular and articular and rheumatism. [20]
- Leaves are active against Micrococus; their juice use for cold, cough, diarrhea, dyspepsia, flatulence, gonorrhoea and leprosy and also Seed oil is used in scabies, leprosy, piles, ulcers, chronic fever, lever pain and lumbago. Roots are used for cleaning gums, teeth and ulcers.
- The bark is used internally for bleeding piles .Juice from plants as well as oil is aseptic. It is said to be an excellent remedy for itch, herpes and pityriasis versicolor. Powdered seeds are valued as febrifuge, tonic and in bronchitis and whooping cough. [13],[17]

Some species of *Pongamia*

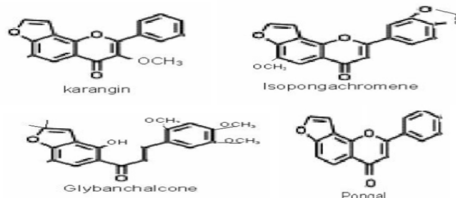
- *Pongamia ovalifolia*
- *Pongamia glabra*
- *Pongamia uliginosa*
- *Pongamia velutina*
- *Pongamia pinnata*

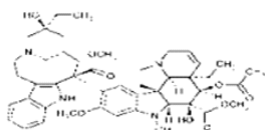
Past Phytochemistry Studies

| S. No | Plant Part Used | Compounds Isolated | Reference |
|-------|-----------------|--|---|
| 1. | Seeds | Demethoxy-kanugin, gamatay, glabrosaponin, kaempferol, kankone, kanugin, karangin, neoglabin, pinnatin, pongamol, pongapin, quercitin, saponin, β-sitosterol and tannin. Lanceolatin B, is o-pongachromene and pongaglabrone. [10],[48],[47] | <ul style="list-style-type: none"> • DukeJA, Hand book of Energy Crops. 1983-30. [47] • Singh RV. Fodder trees of India .Oxford & IBH Co. New Delhi, India.1982. [48] • Warriar P K, Hyderabad,1995, 339-344. [10] |

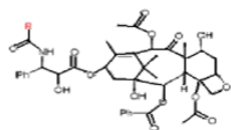
| | | | |
|----|-----------------|--|--|
| 2. | Bark | 3-methoxy-(3,4-dihydro-3-hydroxy-4-acetoxy)-2,2-dimethylpyrano-(7,8:5,6)-flavone and 3-methoxy-(3,4-dihydro-4-hydroxy-3-acetoxy)-2,2-dimethylpyrano-(7,8:5,6)-flavone, were isolated, along with six known compounds, caryophyllene oxide, obovatachalcone, 8-hydroxy-6-methoxy-3-pentyl-1H-isochromen-1-one,6,7,2,2-dimethylchromono-8,-dimethylallylflavanone, isolonchocarpin, ovaliflavanone | <ul style="list-style-type: none"> • Hao Yin, Si Zhang,.et al Chem. Soc, 17(7), 2006, 1432-1435. [21] |
| 3. | Leaves | Isoflavonoid diglycosides, 4'-O-methyl-genistein 7-O-beta-D-rutinoside and 2',5'-dimethoxy-genistein 7-O-beta-D-apiofuranosyl-(1''6'')-O-beta-D-glucopyranoside, and a new retinoid, 12a-hydroxy-alpha-toxicarol, together with nine known metabolites, vecinin-2, kaempferol 3-O-beta-D-rutinoside, rutin, vitexin, isoquercitrin, kaempferol 3-O-beta-D-glucopyranoside, 11,12a-dihydroxy-munduserone, kaempferol, and quercetin [50] [25]-[26] [22]-[23] [49] | <ul style="list-style-type: none"> • Mahendra International journal of Pharma and Bio science, 1(3), 2010, 1-6. [49] • Marzouk MS, et al 63(1-2),2008,1-7. [50] • Agbor GA, Leopold T, et al 18(11), 2004, 873-876. [22] • Oben JE, Assi SE, African J Traditional Complimentary Alternative Med, 3(1), 2006, 95-100. [23] • DukeJA, Hand book of Energy Crops 1983. [25] • Singh RV Fodder trees of India .Oxford & IBH Co. New Delhi, India.1982. [26] |
| 4. | Seed oil | Methyl oleate and 3'-methoxy (2'' ,3'' :7,8) furanoflavone. [10]- [24] Karanjin, pongamol, pongapin and Kanjone. Glabrachalcone. [27] | <ul style="list-style-type: none"> • Warriar P K, Hyderabad,1995, 339-344. [10] • Singh MP, Himadri Panda.Medicinal Herbs with Their Formulations. Daya publishing House, Delhi, 2005, 678-680. [24] • Khare CP. Indian medicinal plants: an illustrated dictionary. Springer science, Berlin, 2007, 209 [27] |
| 5. | Flowers | Hydroxyl furanoflavones, chemooflavanone, triterpenes, beta sitosterol glucoside and aurantiamide acetate. [30] | <ul style="list-style-type: none"> • Bhattacharjee, S.K., 2001 [30] |
| 6. | Roots | Paclitaxel, Fluorophenylalaline, Vinblastin, Vincristine (Sulphate), Teniposide, Fluoxetine, Oetoposide. [28] | <ul style="list-style-type: none"> • Sagar PK, 2003, 103-106. [28] |

Some Isolated Compounds: (1)[64]

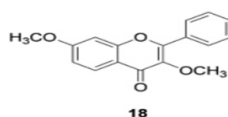




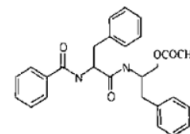
Vinblastin



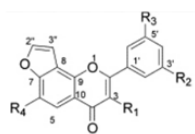
Paclitaxel



3,7-dimethoxy-2(3',4'-methylenedioxy-phenyl)-chromen-4-one (18)

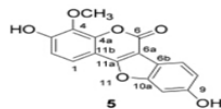


Aurantiamide acetate

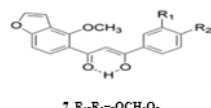


1. R₁=R₃=OCH₃, R₂=OH, R₄=H
2. R₁=R₂=R₃=OCH₃, R₄=H
3. R₁=OCH₃, R₂=OH, R₃=R₄=H
4. R₁=OCH₃, R₄=OH, R₂=R₃=H

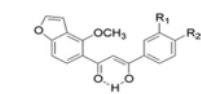
Pongapinnol A-D (1-4)



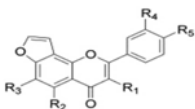
Pongacoumestan (5)



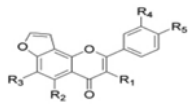
7. R₁, R₂=-OCH₃-1-(4-methoxy-5-benzofuranyl)-3-(3',4'-methylenedioxy-phenyl)-1,3-



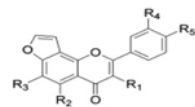
6. R₁=R₂=H
1-(4-methoxy-5-benzofuranyl)-propanedione(7)
3-phenyl-1,3-propanodione (6)



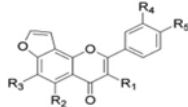
8. R₁=OCH₃, R₂=R₃=R₄=H
3-methoxy furo[8,7:4'',5''] flavone (8)



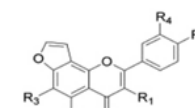
9. R₁=R₂=R₃=OCH₃, R₄=H
Furo[8,7:4'',5''] flavone (9)



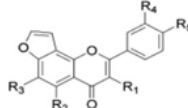
10. R₁=OH, R₂=R₃=R₄=H
5'-hydroxy furo[8,7:4'',5''] flavone (10)



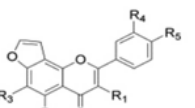
11. R₂=OCH₃, R₁=R₃=R₄=H
5-methoxy furo[8,7:4'',5''] flavone (11)



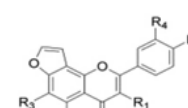
12. R₁=OH, R₂=R₃=R₄=H
3'-hydroxy furo[8,7:4'',5''] flavone (12)



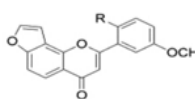
13. R₂=OCH₃, R₁=R₃=R₄=H
6'-methoxy furo[8,7:4'',5''] flavone (13)



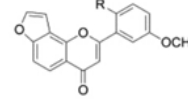
14. R₁, R₂=-OCH₂O-, R₃=R₄=H
3',4'-methylenedioxy furo[8,7:4'',5''] flavone (14)



15. R₂=OCH₃, R₁, R₃=-OCH₂O-, R₄=R₅=H
3-methoxy,3',4'-methylenedioxy furo[8,7:4'',5''] flavone (15)



16. R=H
3'-methoxy furo[8,7:4'',5''] flavone (16)



17. R=OCH₃
2',5'-dimethoxy furo[8,7:4'',5''] flavone (17)

Past Pharmacological Works

| S. No | Plant Part Used | Activity Done | Reference |
|-------|-----------------|---|--|
| 1. | Leaves | Anti-inflammatory activity ^[51] Anti-pyretic action ^[52] Anti-microbial activity ^[52] Anti-diarrhoeal action ^[45] Anti-viral activity. ^[58] Anti-filarial activity. ^[59] Anti-lice activity. ^[60] ^[61] Dyspepsia Gonorrhoea ^[34] ^[30] Leprosy. ^[34] ^[30] | · Srinivasan et al., 2001. ^[51] · Srinivasan et al., 2003. ^[52] · Brijesh et al., 2006. ^[45] · Rameshthangam and Ramasamy, 2007). ^[58] · Uddin et al. (2007). ^[59] · Mumcuoglu, 1999; Yang et al., 2004. ^[60] · Shirwaiker et al., 2004. ^[61] · Ambasta et al., 1992. ^[34] · Bhattacharjee, 2001 ^[30] |
| 2. | Flowers | Anti-hyperglycemic activity Anti-lipidperoxidative activity ^[53] Anti-hyperammonemic activity ^[54] ^[55] ^[56] Anti-oxidant activity. ^[61] Bleeding piles. ^[46] | · Punitha and Manohar, 2006. ^[53] · Essa et al. (2005). ^[54] · Dakshayani et al., (2002). ^[55] · Satyavati et al., 1987. ^[56] · Shirwaiker et al. (2004). ^[61] · Baral and Kurmi, 2006. ^[46] |
| 3. | Oil | Anti-fungal activity Anti-bacterial activity. ^[57] Anti helminthic Leprosy Piles Ulcers Chronic fever Liver pain. ^[10] Rheumatism arthritis Scabies ^[41] Whooping cough. ^[40] | · Wagh et al., 2007. ^[57] · Warriar et al., 1995. ^[10] · Prasad and Reshmi, 2003. ^[41] · CSIR, 1948-98. ^[40] |
| 4. | Fruits | Anti-filarial activity ^[59] Abdominal tumors ^[35] Female genital tract Leprosy Tumour Piles Ulcers ^[37] | · Uddin et al. (2007). ^[59] · Hartwell, 1967-1971. ^[35] · Rastogi and Mehrotra, 1960-1969. ^[37] |
| 5. | Seeds | Nootropic activity ^[62] ^[63] Hypertension Skin ailments Rheumatic arthritis. ^[37] ^[38] ^[39] Bronchitis Whooping cough. ^[40] Inflammations Pectoral diseases Chronic fevers Hemorrhoids Anemia. ^[10] | · Singh et al., (1996). ^[62] · Singh et al. (1997). ^[63] · Ballal, 2005. ^[37] · Tanaka et al., 1992. ^[38] · Carcache et al., 2003. ^[39] · CSIR, 1948-1998. ^[40] · Warriar et al., 1995 ^[10] |
| 6. | Roots | Anti-Nociceptive activity. ^[52] anti-Helminthic activity Vaginal and Skin diseases. ^[31] Gonorrhoea. ^[29] | · Srinivasan et al., 2003. ^[52] · Gills et al., 1998. ^[31] · Joshi, 2006 and Manandhar, 2002. ^[29] |
| 7. | Stem | CNS sedative Anti-pyretic activity. ^[33] | · Philip and Sharma, 1997. ^[33] |
| 8. | Bark | Bleeding piles Beriberi Swelling of the spleen ^[42] Mental disorder Cough and cold. ^[43] | · Kirtikar and Basu, 1984. ^[42] · Manandhar, 2002. ^[43] |

Conclusion

The extensive literature survey revealed that *Pongamia Pinnata* L. is

important medicinal plant with diverse pharmacological and phytochemical spectrum. The plant shows the presence of many chemical constituents like alkaloids, tannins, steroids, glycosides, demethoxy-kanugin, glabrin, kanugin, karangin, flavonoids and fixed oils which are responsible for varied pharmacological and medicinal properties like Anti-inflammatory activity, Anti-pyretic action, Anti-microbial activity, Anti-diarrhoeal action, Anti-viral activity, Anti-hepato-protective activity, Anti-filarial activity, Dyspepsia, Gonorrhoea, Leprosy, Anti-hyperglycemic activity, Anti-lipidperoxidative activity, Anti-hyperammonemic activity, Anti-oxidant activity and Bleeding piles. Furthermore, it also represents a milestone in the field of bio fuel industry as one of the most important bio fuel crop. However, evaluation needs to be carried out on *Pongamia Pinnata* L. in order to explore the concealed areas and their practical clinical applications, which can be used for the welfare of the mankind.

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