IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A Short Review On Versatile Leguminous Plant Pongamia Pinnata.

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Abstract:

Pongaemia Pinnata is a traditional plant with huge medicinal value.Conventional natural plants are more preferrable compared to synthetic drugs,because these drugs are gift by nature to the mankind.

Keywords:

Antihyperglycemic,Antilipidemic,Analgesic,Antidiabetic

Introduction:

On a global scale, traditional medicines play a critical role in the treatment of health issues. Both conventional and modern medicine still benefit from the useful therapeutic compounds that medicinal plants give [1]. Traditional medicines are becoming more and more important due to the negative impacts of modern medicine, and research is currently being done to determine the scientific underpinnings of these remedies' therapeutic effects [2]. The study of medicinal plants has become more intense, and knowledge about these plants has been shared. This study is expected to reduce reliance on synthetic medications and advance scientific investigation into medicinal plants for human benefit [3]. The medium-sized tree Pongamia pinnata Linn Pierre (Fabaceae) grows quickly and is a member of the Leguminosae family [4]. It is a significant minor oilseed tree that is not edible. In English, it is also known as the "Karum Tree" or the "Poonga Oil Tree" [5]. It is primarily indigenous to Asia's hot, dry climates. In India, pogamia trees are grown for economic purposes. The literature of the conventional medical system also mentions this plant's therapeutic uses. The ancient plant known as karanja (P. pinnata) is mentioned in the Vedas, Samhita, and nearly every Nighantu (Dictionary) [6]. It consists of a variety of chemical substances, including hormones, karangin, glabrin, kanugin, tannins, glycosides, alkaloids, and fixed oils [7]. These substances have the potential to have a range of health benefits, including anti-inflammatory, anti-nociceptive, antioxidant, anti-diarrheal, anti-fungal, anti-plasmodial, anti-ulcer, anti-hyperglycemic, anti-oxidative, anti-hyperammonemic, and analgesic properties [8,9]. P. pinnata is a plant whose whole plant has historically been regarded as a crude drug [10]. Agriculture and the environment both make use of it. The plant's seeds are recognized as possible sources of biodiesel [11] that have a high content of polyunsaturated fatty acids and roughly 28–34% oil [12]. It is well known that P. pinnata's extensive network of lateral roots inhibits soil erosion. Plants can be cultivated using a variety of techniques, such as direct seeding, nurturing the seed in a nursery, and planting with stump cuttings. But because seed doesn't need to be treated beforehand and sprouts in a week to a month, it's the most popular method [13]. The tree's many uses for all of its parts—especially the seeds and roots—have led to its enormous medicinal and economic value [14]. The goal of this review study is to present

comprehensive information about the basic characteristics, phytochemicals, and diverse medicinal uses of P. pinnata. Tables 1 and 2 provide P. pinnata (L.)'s taxonomy and colloquial names, respectively.

Pinnata P. Other synonyms for Linn pierre include [15], Pongamia glabra vent, Millettia pinnata (L.) Panigrahi, and Derris indica (Lam).

Taxonomy:

Plantae is a kingdom; Tracheobionta is a subkingdom; Spermatophyta is a superdivision; Magnoliophyta is a division; Magnoliopsida is a class; Rosidae is a subclass; Fabales is an order; Millettia Wight & Arn is a species; The pongame oil tree, Panigrahi .[16]

Geographical Distribution:

It is extensively dispersed across tropical Asia, the Seychelles Islands, South Eastern Asia, Australia, and India. It is also locally distributed along riverbanks in the Indian state of Maharashtra; it is particularly common close to the coast in tidal and beach forests in the Konkan region and along Deccan rivers [17].

Botanical Distribution:

The Pongamia pinnata is a rapidly growing tree that can reach 40 feet in height and spread, generating a broad, spreading canopy that provides moderate shade, according to Allen and Allen (1981). Type of plant a medium-sized deciduous, evergreen, perennial tree.
Elevation: 35 to 40 feet
Growth Pace: Quick
Medium-textured
Number of chromosomes: 22
increasing demands
Lightweight prerequisite: Trees thrive under direct sunlight.
Tolerances for soil types include clay, loam, sandy, somewhat alkaline, acidic, and well-drained.
High tolerance to drought
Tolerance to aerosol salts: modest
Winter interest: not particularly cold (a) Leaf varying, strange, pinnately complex, hairless, evergreen, and 2 to 4 inches.

(b) Pink and lavender flowers with white petals that are grouped in pairs and have short stalks. The flowers are 15–18 mm long. (a) Pods: 3–6 cm long and 2-3 cm wide, smooth, brown, hard, indehiscent, and have one to two seeds.
(c) Seed: Ovoid or elliptical, compressed, shaped like a bean, 10–15 cm long, dark brown, and greasy.
(d) There are many, well-developed lateral roots and a thick, lengthy taproot.

(e) Bark thin on the inside, yellow and gray to grayish brown. Care and Pruning All parts of the plant are toxic and will induce nausea and vomiting if eaten[18]

Synonyms:

Other names for Pongamia pinnata linn pierre include Millettia pinnata (L.) Panigrahi, Pongamia glabra vent, and Derris indica (Lam) [19].

Phytochemistry:

Pongamia pinnata was found to contain a large number of prenylated flavonoids, including furanoflavones, furanoflavonols, furanochalcones, and pyranochalcones, according to phytochemical research [20, 21–23]. Pongaflavanol (1) and tunicatachalcone (2), two phenylated flavonoid derivatives with a modified ring A, were extracted from Pongamia pinnata stem bark by Yin et al. [24]. The structure of pongaflavanol, a novel chemical, was determined by interpreting spectroscopic data. Compound 2, tunicatachalcone, was initially isolated from Pongamia pinnata, and constituted the first example of a naturally occurring prenylated flavan-4-ol with a modified ring A [24].

Together with thirteen known chemicals, [25] discovered four novel furanoflavonoids, pongapinnol A–D, and a new coumestan, pongacoumestan, from the fruits of Pongamia pinnata. They used the analysis of spectroscopic data to clarify the structures of isolated molecules [25]. Li et al. isolated and characterized 16 known flavonoid metabolites as well as five structurally unique flavonoids called pongamones A–E. [26] from Pongamia pinnata's stem. Based on spectroscopic investigations and a comparison of their spectroscopic data with those of comparable compounds described in the literature, their structures were ascertained [26]. The oil extracted from the seeds of Karanja (Pongamia pinnata) includes karanjin, a bioactive compound with significant biological properties [27]. Vismaya et al. [27] created a simple technique for effective karanjin recovery. They used methanol to extract the seed oil liquid-to-liquid. HPLC was used to determine the purity of karanjin, which was obtained by crystallizing the extract after it had been further refined using chromatography on alumina. The amount of karanjin recovered was 20% with a purity level of >95%. By using NMR and MS spectral analysis, the compound's structure was clarified [27].

From the seeds of Pongamia pinnata, six compounds—two sterols, three sterol derivatives, and one disaccharide—as well as eight fatty acids—three saturated and five unsaturated—have been identified. Physicochemical and spectroscopic approaches were employed to clarify their structures. It is the first time that the metabolites of this plant, beta-sitosteryl acetate and galactoside, stigma sterol, its galactoside, and sucrose, have been reported. The amounts of the saturated and unsaturated fatty acids—two monoenoic, one dienoic, and two trienoic—were precisely equal. The most common acids were oleic acid (44.24%), followed by stearic acid (29.64%) and palmitic acid (18.58%). Trace levels (0.88%) of octadecatrienoic and hiragonic acids were found. It has been possible to isolate and describe karangin, pongamol, pongagalabrone, and pongapin, pinnatin, and kanjone from seeds. 'Pongol' is a flavone derivative found in immature seeds. 'Glybanchalcone, isopongachromene' is the other flavonoid that was extracted from the seeds. Numerous flavone and chalcone derivatives, including pongagelone A and B, Galbone, Pongalabol, and Pongone, are found in the plant's leaves and stem [28].

Biological and pharmacological activities:

According to academics, there has been a lot of interest in Pongamia pinnata during the past few years. Numerous pharmacological investigations on Pongamia pinnata have been carried out recently. The results of these investigations are summarized in the section below.

Antihyperglycemic and antilipidperoxidative effects:

In diabetic mice given alloxan, Punitha and Manohar assessed the antihyperglycemic and antilipidperoxidative properties of an ethanolic extract derived from Pongamia pinnata (Linn.) Pierre flowers. In rats given alloxan-induced diabetes, they observed hyperglycemia, increased lipid peroxidation [thiobarbituric acid reactive substances (TBARS)], and disrupted nonenzymatic [vitamins E, C, and glutathione] and enzymatic antioxidant status. In alloxan-induced diabetic mice, they documented the strong antihyperglycemic and antilipidperoxidative effects of oral treatment of Pongamia pinnata flower ethanolic extract (300 mg/kg bw) in addition to an improvement in antioxidant defense system.. Nevertheless, in normal rats given the extract, no appreciable alterations in blood glucose, lipid peroxidation, or antioxidant status were seen. Additionally, in alloxan-induced diabetic rats, the extract significantly decreased blood glucose concentration in a manner comparable to that of the reference medication, glibenclamide (600 mg/kg bw), indicating the potential use of Pongamia pinnata as a secure substitute antihyperglycemic medication for diabetic patients . The existence of many bioactive antidiabetic principles and their synergistic capabilities was identified as the cause of the antihyperglycemic action of the ethanolic extract of Pongamia pinnata flowers[29].

Influence of circardian variation on lipid peroxidation products and antioxidants:

Essa and Subramanian assessed the effects of Pongamia pinnata on antioxidants and lipid peroxidation products in hyperammonemic rats with regard to circadian fluctuations. They examined the features of the 24-hour rhythms (acrophase, amplitude, and mesor) of antioxidants (catalase (CAT), reduced glutathione (GSH), glutathione peroxidase (GPx), superoxide dismutase (SOD), and thiobarbituric acid reactive substances, or TBARS), and lipid peroxidation products (TBARS). In hyperammonemic rats, there was

elevated lipid peroxidation (increased mesor of TBARS) correlated with decreased antioxidant activity (decreased mesor of GPx, GSH, SOD, and CAT). It was concluded that understanding circadian rhythms in both normal and pathological conditions can aid in improving understanding of the pathophysiological process and therapeutic approach to illness. They proposed that Pongamia pinnata may modulate these alterations during hyperammonemic conditions, which may also play a crucial role in disease development[29].

Antihyperammonemic effect:

The preventive effect of Pongamia pinnata (Karanja) leaf extract on blood ammonia and urea levels in ammonium chloride-induced hyperammonemia was assessed by Essa et al.There is substantial evidence linking oxidative stress to hyperammonemia, and ammonium (acetate/chloride) salts partially cause hyperammonemia through oxidative stress. In their investigation, they found that rats treated with ammonium chloride had significantly higher blood ammonia, circulatory urea, uric acid, non-protein nitrogen, and creatinine levels; rats treated with Pongamia pinnata leaf extract plus ammonium chloride had much lower levels of these substances. Comparing the body weights of the experimental animals to the controls revealed no discernible differences. The extract's nephroprotective action through the detoxification of excess urea and creatinine, as well as its antioxidant and free radical scavenging properties, were attributed to its antihyperammonemic impact. Moreover, flavanoids interact with a variety of biomolecules to modify the activity of different enzyme systems, making them strong antioxidants. Numerous bioflavonoids, including kaempferol, quercetin, karanjin, kanjone, pongaglabrone, gammatin, pongaglabol, and kanugin, have been linked to the plant[29].

Antifungal and antibacterial activity:

Wagh et al. evaluated the antifungal and antibacterial activity of various concentrations of oil extracted from Pongamia pinnata against A. fumigatus, Aspergillus niger, Staphylococcus aureus, and Pseudomonas aeruginosa by using the dry-weight method and Minimum Inhibitory Concentration (MIC) determination. Fatty acid was detected in oil through chemical analysis using gas chromatography (GC) and gas chromatography/mass spectrometry (GC-MS). They recommended using this plant's fatty oil to create antibacterial medications made from plants[29]. Antiinflammatory activity:

Pongamia pinnata root extracts were tested for their anti-inflammatory properties by Singh and Pandey. The root extracts exhibited noteworthy anti-inflammatory properties in carrageenin and PGE1-induced oedema models, when compared to phenylbutazone. Prostaglandin inhibition was suggested as a potential mechanism of action, particularly for the ethanolic and acetate extracts. It was discovered that the butanol extract worked well with carrageenin but not with the PGE1 model of inflammation. Rather than lipophilic or very polar elements, the anti-inflammatory effect seems to be mostly found in the intermediately polar constituents. Additionally, the Pongamia pinnata seed extract in petroleum ether shown strong acute anti-inflammatory properties, but the aqueous suspension exhibited pro-inflammatory effects. In further investigations, the bradykinin-induced oedema model had the greatest anti-inflammatory impact. Reduced capillary permeability and suppression of prostaglandin production could be the mechanism of action.Because of their lipophilic components, petroleum ether extract and aqueous extract prevented histamine and 5-hydroxytryptamine-induced inflammation, most likely preventing the initial phases of inflammation.The fractions, however, had no effect on Freund's adjuvant-induced arthritis model.The plant's application in treating rheumatoid arthritis is overlooked in the subsequent discovery[29].

Antiviral activity:

The majority of the globally significant commercially farmed marine crustacean species are impacted by the highly pathogenic, highly transmissible White Spot Syndrome Virus (WSSV), which is the source of the White Spot Syndrome in shrimp and results in substantial mortality. The antiviral activity of bis (2-methylheptyl) phthalate, which was isolated from Pongamia pinnata leaves, was assessed by Rameshthangam and Ramasamy. against the Penaeus monodon Fabricius virus that causes White Spot Syndrome. The survival rate of Penaeus monodon infected with WSSV has been seen to rise upon oral

administration of ethanolic extract and purified substance derived from Pongamia pinnata leaves. The shrimp were given pelletized feed that had been treated with an ethanolic extract of Pongamia pinnata leaves at 200 and 300 microg/g of body weight per day, both before and after WSSV infection. When given 200 or 300 microg extract/g, the WSSV-infected shrimp had a survival rate of 40% and 80%, respectively[29].

Antifilarial potential:

The antifilarial activity of Pongamia pinnata fruit and leaf extracts on the cattle filarial parasite was studied by Uddin et al.The whole worm's spontaneous movements and the S. cervi nerve-muscle preparation were inhibited in their examination by the aqueous and alcohol extracts of fruits and the alcohol extract of leaves. For the aqueous, fruit, and leaf alcohol extracts, the concentration needed to stop the whole worm preparation moving was 250µg/mL, 120µg/mL, and 270µg/mL, respectively. Pongamia pinnata extract doses of 25, 5, and 20 µg/mL were needed to have a comparable effect on the nerve-muscle preparation, respectively, indicating a cuticular permeability barrier[29].

Action against infectious diarrhea:

Gastrointestinal diseases, which predominantly affect children in developing nations and kill about 1.8 million people annually worldwide, are the most common cause of diarrhea.Dehydration, which is brought on by the loss of electrolytes in diarrheal stools, is the primary cause of death from diarrhea. Pongamia pinnata (L.) leaves The most prevalent cause of diarrhea is gastrointestinal tract infections, which can be treated with Pierre (also known as P. glabra vent) as a treatment.P. pinnata has been shown to be useful in reducing castor oil-induced diarrhea, according to Shoba and Thomas.There is a lack of information regarding the mode of action of medicinal plants on different aspects of diarrheal pathogenicity, such as colonization to intestinal epithelial cells and production/action of enterotoxins, despite data being available on the effect of these plants on intestinal motility and their antibacterial action [Brijesh et al] assessed the antimicrobial (antibacterial, antigiardial, and antirotaviral) effects of a crude decoction of dried Pongamia pinnata leaves. They also examined the effect of the decoction on the production and action of enterotoxins (E. coli stable toxin, ST; cholera toxin, CT; Escherichia coli labile toxin, LT; and E. coli pathogenic E. coli adhering to epithelial cells, as well as the invasion of enteroinvasive E. coli and Shigella flexneri). The infusion was observed to decrease CT synthesis and bacterial penetration of epithelial cells, but it exhibited no antibacterial, antigiardial, or antirotaviral properties. These findings suggested that P. pinnata's crude decoction had a specific antidiarrheal effect that is effective against enteroinvasive bacterial strains that cause episodes of bloody diarrhea and cholera. They linked the compound's antimotility, antisecretory, and antibacterial properties to its antidiarrheal properties[29].

Nootropic activity:

Rats' pentobarbitone sleeping time was lowered by a variety of extracts made from Pongamia pinnata (Karanj) seeds in the study conducted by Singh et al. The activation of the hepatic microsomal enzyme system was suggested as the likely mechanism of action.Additionally, Singh et al.assessed the Pongamia pinnata roots' comparable qualities. Pentobarbitone sleeping time was increased in their study by the petroleum ether extract (PEE) of the roots, most likely as a result of CNS depression. A nootropic test was conducted on the PEE of Pongomia pinnata seeds using an experimental model of Alzheimer's disease, which was established by lesioning the nucleus basalis magnocellularis with ibotenic acid. After two weeks of treatment, it corrected both the decline in cholinergic indicators and the cognitive abnormalities. One potential mechanism was the reversal of disrupted cholinergic function[29].

Antinociceptive activity:

An evaluation of the analgesic efficacy of Pongamia pinnata root extracts was conducted by Srinivasan et al. In the tail flick test, the petroleum ether extract (PEE), n-butanol extract (BE), and ethanol extract (EE) of Pongamia pinnata roots had a substantial analgesic effect. At doses more than 100 mg/kg, the seeds' PEE and direct EE also demonstrated a considerable analgesic effect[29].

Protective effect against nephrotoxicity:

Shirwaikar et al investigated the preventive potential of an ethanolic extract of Pongamia pinnata flowers against renal damage in rats produced by cisplatin and gentamicin. Pongamia pinnata flowers showed protection against renal impairment caused by cisplatin and gentamicin when the extract (300 & 600 mg/kg) was given orally for 10 days after cisplatin (5 mg/kg, i.p.) on day 5. Its antioxidant activity was suggested as a potential mechanism for its protection against nephrotoxicity[29].

Ulceroprotective activity:

When rats treated with acetylsalicylic acid (ASA) were given an aqueous extract of Pongamia pinnata root, the rats' gastric juice volume, acid output, and peptic activity significantly decreased, but their mucin activity remained same. In addition, It markedly reduced the ulcer index. The methanolic extract of Pongamia pinnata roots was found to have an ulcer-protective effect by increasing mucosal defensive factors such as mucin secretion, mucosal cell life span, glycoproteins in mucosal cells, cell proliferation, and prevention of lipid peroxidation, instead of attacking the offensive acid-pepsin secretion. Mucin activity did not alter, despite a qualitative shift in the hexose and fructose levels of carbohydrates[29].

Antidiabetic activity:

Using an Alloxan monohydrate-induced diabetic rat model, the antidiabetic potential of the ethanolic and ethanolic extracts of P. pinnata's stem bark was assessed. The results showed that both extracts had strong activity, but the ethanolic extracts significantly reduced the level of serum biomarkers [30].

Traditional uses of Pongamia pinnata:

Pongamia pinnata seed oil has therapeutic qualities and is applied to skin conditions such as abscesses and itchiness.

- Flowers are recommended as a treatment for diabetes and glycosuria.
- The bark is taken internally for diabetes bleeding piles, beriberi, and as an antibiotic.
- In instance, the Indian Ayurvedic and Sidda medical systems use karanja seed as a therapeutic herb.
- Crude seed extract has hypoglycemic, anti-oxidative, anti-ulcerogenic, anti-inflammatory, and analgesic qualities in addition to its ability to totally suppress the growth of herpes simplex virus types 1 and 2 in Vero cells.
- Various plant parts have been utilized in traditional medicine to treat rheumatic joints, whooping cough, bronchitis, and to relieve dipsia in people with diabetes.
- The leaves treat wounds, piles, and other inflammations and are hot, laxative, digestive, and anthelmintic.
- For the purpose of treating rheumatic aches and cleaning ulcers caused by gonorrhea and scrofulous enlargement, a hot infusion of leaves is used as a medicinal bath.
- Leucoderma, leprosy, lumbago, rheumatism, and muscular and articular disorders are among the infectious diseases that are treated using various extracts of leaves, roots, and seeds.
- Leaf juice is used for colds, coughs, diarrhea, dyspepsia, flatulence, gonorrhea, and leprosy.
- Leaves are active against Micrococus. Leprosy, lumbago, scabies, ulcers, persistent fever, and piles can all be treated with seed oil.
- Roots are used to treat ulcers, teeth, and gums. To treat bleeding piles, the bark is applied internally.Both plant juice and oil are aseptic.
- It is reputed to be a fantastic treatment for pityriasis versicolor, herps, and itching.
- Powdered seeds are useful as a tonic, febrifuge, and in cases of whooping cough and bronchitis.
- Blooms are applied to people with diabetes. For beriberi, bark has been utilized [31].

Conclusion:

Pongaemia Pinnata is one of the very common plant having number of pharmacological activities.A wide range of therapeutic values can be achieved with zero adverse effects.

REFERNCES:

1.Krentz AJ, Bailey CJ. Oral antidiabetic agents: current role in type 2 diabetes Drugs. 2005 Feb;65:385-411.

2.Gupta YK, Briyal S. Animal models of cerebral ischemia for evaluation of drugs. Indian J Physiol Pharmacol. 2004 Oct 1;48(4):379-94.

3. Arote SR, Yeole PG. Pongamia pinnata L: a comprehensive review. Int J Pharm Tech Res. 2010 Oct;2(4):2283-90.

4. Bala M, Nag TN, Kumar S, Vyas M, Kumar A, Bhogal NS. Proximate composition and fatty acid profile of Pongamia pinnata, a potential biodiesel crop. Journal of the American Oil Chemists' Society. 2011 Apr;88(4):559-62.

5. Sangwan S, Rao DV, Sharma RA. A review on Pongamia pinnata (L.) Pierre: A great versatile leguminous plant. Nature and science. 2010;8(11):130-9.

6. Divakara BN, Alur AS, Tripati S. Genetic variability and relationship of pod and seed traits in Pongamia pinnata (L.) Pierre., a potential agroforestry tree.

7. Rao BG, Reddy SJ, Ramadevi D, Heera B. Phytochemical and Pharmacological studies on Pongamia pinnata. Indian Journal of Research. 2018;7(2):489-92.

8. Tanaka T, Iinuma M, Yuki K, Fujii Y, Mizuno M. Flavonoids in root bark of Pongamia pinnata. Phytochemistry. 1992 Mar 1;31(3):993-8.

9.Chopade VV, Tankar AN, Pande VV, Tekade AR, Gowekar NM, Bhandari SR, Khandake SN. Pongamia pinnata: Phytochemical constituents, traditional uses and pharmacological properties: A review. International Journal of Green Pharmacy (IJGP). 2008;2(2).

10.Meera B, Kumar S, Kalidhar SB. A review of the chemistry and biological activity of Pongamia pinnata.

11.Meher LC, Dharmagadda VS, Naik SN. Optimization of alkali-catalyzed transesterification of Pongamia pinnata oil for production of biodiesel. Bioresource technology. 2006 Aug 1;97(12):1392-7.

12.Kumar D, Singh B, Sharma YC. Bioenergy and phytoremediation potential of Millettia pinnata. Phytoremediation potential of bioenergy plants. 2017:169-88.

13.Arpiwi NL, Yan G, Barbour EL, Plummer JA. Genetic diversity, seed traits and salinity tolerance of Millettia pinnata (L.) Panigrahi, a biodiesel tree. Genetic Resources and Crop Evolution. 2013 Feb;60:677-92.

14.Yadav RD, Jain SK, Alok S, Prajapati SK, Verma A. Pongamia pinnata: an overview. International Journal of Pharmaceutical Sciences and Research. 2011 Mar 1;2(3):494.

15.Thakur SH, Kaurav HE, Chaudhary GI. Karanj (Pongamia Pinnata)–an ayurvedic and modern overview. Asian J Pharm Clin Res. 2021;14(6):14-21.

16.Arote SR, Yeole PG. Pongamia pinnata L: a comprehensive review. Int J Pharm Tech Res. 2010 Oct;2(4):2283-90.

17.Prajapati ND, Purohit SS, Sharma AK, Kumar T. A Handbook of Medicinal Plants (Agrobios, Jodhpur).

18.Sangwan S, Rao DV, Sharma RA. A review on Pongamia pinnata (L.) Pierre: A great versatile leguminous plant. Nature and science. 2010;8(11):130-9.

19.Pulipati S, Babu PS, 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):459-63.

20. Pulipati S, Babu PS, 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):459-63.

21.Carcache-Blanco EJ, Kang YH, Park EJ, Su BN, Kardono LB, Riswan S, Fong HH, Pezzuto JM, Kinghorn AD. Constituents of the Stem Bark of Pongamia p innata with the Potential to Induce Quinone Reductase. Journal of Natural Products. 2003 Sep 26;66(9):1197-202.

22.Yadav PP, Ahmad G, Maurya R. Furanoflavonoids from Pongamia pinnata fruits. Phytochemistry. 2004 Feb 1;65(4):439-43.

23.Yin H, Zhang S, Wu J. Prenylated flavonoids from Pongamia pinnata. Zeitschrift für Naturforschung B. 2005 Mar 1;60(3):356-8.

24.Yin H, Zhang S, Wu J, Nan H, Long L, Yang J, Li Q. Pongaflavanol: a prenylated flavonoid from Pongamia pinnata with a modified ring A. Molecules. 2006 Oct 20;11(10):786-91.

25.Yadav PP, Ahmad G, Maurya R. Furanoflavonoids from Pongamia pinnata fruits. Phytochemistry. 2004 Feb 1;65(4):439-43.

26.Li L, Li X, Shi C, Deng Z, Fu H, Proksch P, Lin W. Pongamone A–E, five flavonoids from the stems of a mangrove plant, Pongamia pinnata. Phytochemistry. 2006 Jul 1;67(13):1347-52.

27.Eipeson WS, Manjunatha JR, Srinivas P, Kanya TS. Extraction and recovery of karanjin: A value addition to karanja (Pongamia pinnata) seed oil. Industrial crops and products. 2010 Sep 1;32(2):118-22.

28.Shameel S, Usmanghani K, Ali MS, Ahmad VU. Chemical constituents from the seeds of Pongamia pinnata (L.) Pierre. Pakistan Journal of Pharmaceutical Sciences. 1996 Jan 1;9(1):11-20.

29.Arote SR, Yeole PG. Pongamia pinnata L: a comprehensive review. Int J Pharm Tech Res. 2010 Oct;2(4):2283-90.

30.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 Jan 1;38(1):62.

31.Arote SR, Yeole PG. Pongamia pinnata L: a comprehensive review. Int J Pharm Tech Res. 2010 Oct;2(4):2283-90.