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Review Article

A Pharmacological Review of Pongamia Pinnata Plant

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ABSTRACT

Pongamia pinnata is one of the significant herbal plants with different therapeutic medicinal properties. Pongamia pinnata also known as Karanja. This plant is substantially cultivated around littoral areas, strands, tidal timbers, and roadsides. Conventionally, the leaves and whole plant were employed in the treatment of numerous diseases. There are various phytochemicals isolated from the pongamia pinnata plant. The plant therapeutically important in traditional medicine as well as in modern medicine. Traditionally the leaves are used in the treatment of many diseases. Whole leaves used as a digestive and laxative and to treat inflammation and wounds. Leaf juice aids in treatment of leprosy, gonorrhea, diarrhea, flatulence, coughs, and snap. Leaf infusions and excerpt palliate rheumatism and itches. All parts of the plant have been used as a crude drug for the treatment of tumours, piles, skin diseases, itches, wounds, ulcers, cleaning teeth, dermetopathi.

INTRODUCTION

Medicinal plants play an important part in mortal lives for many years to treat various conditions all over the world. Plants are the different patron of bioactive composites that make them a rich source of different types of drugs [1]. Today, there is wide interest in medicines obtained from natural plants for their various therapeutic properties. Pongamia pinnata Linn Pierre (Fabaceae) is a fast-growing medium sized tree that belongs to the Leguminosae family [2]. Historically, pongamia has been used as folk medicinal tree, particularly in Ayurveda and Siddha systems of Indian drug [3].

Taxonomical classification [4]

Kingdom - Plantae

Subkingdom - Tracheobionta

Super division - Spermatophyta

Division - Magnoliophyta

Class - Magnoliopsida

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Subclass - Rosidae

Order - Fabales

Family - Leguminosae

Genus - Pongamia

Botanical name- Pongamia pinnata (L.) Pierre

Vernacular names [5]

Different vernacular names of Pongamia pinnata have been reported as follows

Language Vernacular name

Telugu Pungu, Ganuga

Sanskrit Ghrtakarauja, Karanjaka, Naktamala, Naktahva

Hindi, Marathi, Guajarati Karanj, karanja

English Indian beech

Tamil Ponga, Pongam

Kannada Honge, Hulagilu

Malayalam Pungu, Punnu, Ungu, Unu, Avittal

Oriya Koranjo

Punjabi Sukhehein, Karanj, Paphri

Assam Kachuw

Bengali Dahara Karanja, Karanja, Natakaranja

Urdu Karanj

Origin and geographical distribution

It was naturally distributed in Asia, now this is set up in Australia, Florida, Hawaii, India, Malaysia, Oceania, Philippines, and Seychelles [6]. It was generally grown in littoral timbers over India and near the aqueducts.

Ecology

Well drained flaxen loams with guaranteed humidity yield the optimum growth. It does n't grow well on dry beach indeed though it saline conditions, alkalinity and water locked soils. It'll also grow on heavy swelling complexion soils. These species come nutrient deficient when their PH rises above 7.5.

Propagation

In situ germination is preferred for this seeds and time limit is within 1-5 weeks of sowing. When the seedlings are roughly 60 cm altitudinous, at the launch of the following stormy season, they should be planted in the field. As youthful shops tolerate shade well a distance of 7.5 by 15cms is recommended. Natural reduplication occurs constantly through root suckers and in large amounts through seeds. Critical weed issues could be brought on by robotic seedlings and root suckers [7].

Morphological characteristics [8]

Flowers are generally with small clusters of white, grandiloquent and pink flowers blowing throughout the time. The raceme like inflorescence bears 2 to 4 flowers which are explosively ambrosial and grow to be 15-18 mm long. Unfolding generally starts after 36 months or more.

Corolla is rounded elliptical shape with rudimentary auricles with a central spot of green colour. Calyx are bell shaped and elide.

Leaves of this tree when youthful they are soft and candescent, sanguine-grandiloquent, and as they get aged, they come lustrous. As the season goes

on, they turn a rich green color with conspicuous modes under. The trees imparipinnate leaves are short stemmed, round or oblong along their length and rounded or cuneate at the base.

Seeds are about 1.5-2.5 cm long with a brittle, unctuous fleece and are unpalatable to beasties. Brown seed capsules appear incontinently after unfolding and develop in 10-11 months. The capsules are thick walled, smooth, kindly flattened and elliptical, but slightly twisted with a short, twisted point. cover product commences when seedlings are 5-7 years old. The capsules generally don't open naturally, and must decay before the seeds can germinate.

Stem is light green in colour with some prickly odour. It has smooth texture on its surface.

The tree contains side roots that grow extensively and a long, thick taproot. Compared to utmost other species, this bone has a larger root spread roughly 9 meters in 17-18 years and produces a lot of root suckers. Because of these characteristics, pongamia is infelicitous for agroforestry and has the implicit to come a weed if not managed precisely.

Medicinal value of different parts of the plant

Different parts of the tree have been used in traditional drug for bronchitis, whooping cough, rheumatic joints and to diabetes. The leaves are hot digestive, laxative, cold wave, cough, diarrhea, dyspepsia, flatulence, gonorrhea, leprosy, anthelmintic, used for inflammations, piles and injuries. It also shows anti-diarrheal, anti-oxidant, anti-ulcer, anti-hyperammonemia, hepatoprotective, anticonvulsant, antidiabetic activity of petroleum ether, chloroform, alcohol and aqueous excerpts of pongamia pinnata leaves excerpts. A hot infusion of leaves is used as a treated bath for relieving rheumatic pain [8].

The seeds are used in bronchitis, habitual fever, whooping cough and chronic skin conditions and painful rheumatic joints, inflammations, pectoral diseases, hemorrhoids and anemia It also has hypotensive, antiviral effects and produce uterine contractions. Seed oil used as an astringent and to kill parasitic worms. Helpful in treating whooping cough, piles, liver pain, habitual fever, ulcers, and leprosy. Relieves sore joints and muscles and arthritis. Used to treat eczema and other skin vexations when mixed with zinc oxide [9].

Stem and bark used in CNS sedative, antipyretic, antidiabetic, analgesic and anti-inflammatory activity.

Dried flowers in powder in combination with other ingredients is given as decoction in diabetes to quench thirst, dyspepsia in diabetes and for bleeding piles. It also shows antihyperglycemic, hypoglycemic, hypolipidemic and renal protective activity [10].

Roots used as a toothbrush for oral hygiene, used for killing parasitic worms, and used to treat vaginal and skin conditions. Juice of roots used to clean ulcers and to close open blisters and mixed with coconut milk and lime water, juice can treat gonorrhea [10,11].

Pharmacological activities

Anti- Ulcer activity

The methanolic extract of roots of pongamia pinnata reported for significant protection against mucosal damage induced by aspirin and has a tendency to decrease acetic-acid induced ulcer after 10-days treatment. The extract showed ulcer protective effect with cessation of mucosal defensive factors like mucin secretion, life span of mucosal cells, mucosal cell glycoproteins, cell

proliferation and prevention of lipid peroxidation [12].

The methanolic extract of seeds was evaluated for the ulcer protective and healing effect in rats. When administered orally, the extract showed dose-dependent (12.5-50mg/kg for 5 days) ulcer protective effect against gastric ulcer induced by 2h cold resistant stress. Optimal effective dose of PPSM (25mg/kg) showed anti-ulcerogenic activity against acute gastric ulcers (GU) induced by pylorus ligation and aspirin and duodenal ulcer induced by cysteamine but not against ethanol-induced GU [13].

Antihyperglycemic and Anti-lipid peroxidative activity

It has been reported that oral administration of ethanolic extract of pongamia pinnata flower shows significant antihyperglycemic and anti-lipid peroxidative effect and enhancement in antioxidant defence system in alloxan induced diabetic rats [14]. Oral administration of the ethanolic extract of the flower (300mg/kg body weight) showed significant antihyperglycemic activity which considerably reduce the blood glucose concentration in a similar extent to that of the reference drug glibenclamide (600microgram/kg body weight) in alloxan - induced diabetic rats. The results suggested that the treatment of pongamia pinnata extract could be used as a safe alternative anti-hyperglycaemic drug for diabetic patients [15].

Antioxidant activities

The defensive part of Pongamia pinnata leaves excerpt was studied on oxidative stress during ammonium chloride convinced hyperammonemia by measuring the extent of oxidative damage as well as antioxidant status [16]. Ethanolic excerpt of Pongamia pinnata (PPEt) leaves was administered orally (300 mg/kg body weight) and the goods of PPEt on the situations of thiobarbituric acid reactive substances (TBARS), hydroperoxides (HP), conjugated diene (CD), superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), and reduced glutathione (GSH) were studied in liver and order of ammonium chloride convinced hyperammonemic rats. On treatment with PPEt, a significant reduction in the situations of TBARS, HP, and CD and a significant increase in the levels of SOD, CAT, GPx, and GSH in liver and order of ammonium chloride convinced hyperammonemic rats were observed, which easily shows the antioxidant property of PPEt. These findings show the defensive part of PPEt against lipid peroxidation and suggest that PPEt possesses antioxidant eventuality that may be used for therapesutic purposes. The antioxidant property may be due to the presence of flavonoids and polyphenol in the excerpt [17].

Antioxidant property observed that effect of Pongamia leaves excerpt on circulatory lipid peroxidation, antioxidant status was estimated in ammonium chloride convinced hyperammonium rats enhanced lipid peroxidation in the circulatory ammonium chloride –treated rats was accounted by a significant drop in the situations of vitamin-C, vitamin-E reduced glutathione peroxidase, superoxide dismutase catalase. It showed that PPEt modulates by reversing the anti-oxidant imbalance during chloride convinced hyperammonemia and this could be due to its anti hyperammonia effect by means of detoxifying redundant ammonia, urea and creatinine and antioxidant property [18].

Anti-inflammatory activity

It has been reported that the 70% ethanolic splint excerpt of P. pinnata retain potent anti-inflammatory exertion against different phases

(acute, sub-acute and chronic) of inflammation without side effect on gastric mucosa. It also showed significant anti pyretic action of the excerpt against brewer's yeast-convinced pyrexia [19].

Antiprotozoal activity

The plant was reported for its anti-plasmodial activity against Plasmodium falciparum [20]. The bark and splint exertion with low 1C50 values of 9-43 mcg/ml has been shown to be implicit as anti-malaria by possessing anti-plasmodial activity. This activity might be due to the presence of lupeol (120), which blocked the invasion of Plasmodium falciparum merozites into erythrocytes at IC50 1.5 mcg/ml. It also reported the inhibition of growth of Trypanosoma cruzi and Leishmania with an IC90 at the dose of 100 mcg/ml. Crude decoction of dried leaves had no activity against trophozoites [21].

Antidiarrheal activity

This activity was determined by evaluating antimicrobial effect of crude decoction of dried leaves of Pongamia pinnata. It also evaluated for its effect on production and action of Enterococcus (cholera toxin, Escherichia coli labile toxin, stable toxin) and adherence of enteropathogenic Escherichia coli and invasion of enteroinvasive Escherichia coli and Shigella flex epithelial cells. This study concludes that decoction of Pongamia pinnata had selective anti-diarrheal action with against cholera and enteroinvasive bacterial causing bloody diarrheal periods among bacterial diarrhoea. These findings back up their long standing utilize as an anti- diarrheal treatment [22].

Antipyretic and antinociceptive activity

The leaves of pongamia pinnata have antinociceptive and antipyretic properties. The authors used rats and mice to assess the body's response to potentially toxic stimuli efficacy of a 70% ethanolic fraction of pongamia pinnata leaves in dissimilar pain sculpts. Pongamia pinnata leaves extract was as well tested for its commotion against fever in rats with Brewer's yeast-induced fever. The extract of pongamia pinnata leaves was found to have momentous antinociceptive and commotion against fever [23,24].

Antibacterial activity

The antibacterial activity of pongamia pinnata leaf chloroform fraction was superior to average adjacent to Escherichia coli, Pseudomonas aeruginosa, and staphylococcus aureus, whereas acetone fraction was extra vigorous than normal in opposition to pseudomonas aeruginosa and Escherichia coli. The petroleum ether fraction did not demonstrate substantial action against bacteria as evaluated to the normal [25,26].

Anti-lice activity

Growing pattern of pediculicidal medicine resistance to words head louse laid the setup magnet for exploration in exploring new anti lice agent for medicinal tree [27,28]. In the study, various excerpts of pongamia pinnata leaves tested against the head louse pediculus humanus capitis. A sludge paper prolixity system was conducted for determining the implicit pediculicidal and ovicidal activity of chloroform, P. E, methanol and water excerpt of pongamia pinnata leaves. The result revealed that P. E. excerpts retain anti and methanol excerpt showed moderate pediculicidal result [29].

The chloroform and methanol excerpts were also successful in inhibiting nymph emergence and the petroleum ether excerpts was the most effective with a complete inhibition of emergence. Water excerpt was devoid of both pediculicidal and

ovicidal conditioning. All the results were well similar with the benzoyl benzoate (25% w/v). These showed the prospect of using pongamia pinnata leave excerpts against pediculus humanus capitis [30].

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 Ramassamy 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 excerpt and purified emulsion from the leaves of pongamia pinnata has increased the survival of WSSV infected Penaeus monodon. Thet 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 [30,31].

Antifilarial activity

Investigated the antifilarial potential of the fruit and leaf extracts of pongamia pinnata on cattle filarial parasite. In their investigation, the aqueous and alcohol extracts of fruits and the alcohol extracts 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 270microgram/mL for alcohol extracts of the leaves and 250 mg/ml alcohol extract of fruits. The concentration of pongamia pinnata extracts required to produce an equivalent effect on the nerve muscle preparation suggesting a cuticular permeability barrier [32].

Antimicrobial activity

The plant materials leaf, bark and seeds were uprooted consecutively with petroleum ether and ethyl acetate. The excerpts tested for antimicrobial exertion against Bacillus subtilis, Staphylococcus aures, Escherichia coli, Pseudomonas aeruginosa and Candida albicans by disc diffusion method. Both the excerpts of splint, dinghy and seeds showed a good zone of inhibition. Both the excerpts showed maximum zone inhibition against Bacillus subtilis while E. coli and C. albicans were unaffected by any of the extracts except petroleum excerpt of dinghy [33].

Various extracts of the plant exhibited antibacterial activity against a broad spectrum of gram negative and gram-positive bacteria, such as Proteus vulgaris, Staphylococcus epidermidis, Staphylococcus aureus, Enterobacter aerogenes, Bacillus subtilis, Salmonella typhimurium, Escherichia coli, Propionibacterium acne, Yersinia enterococci, Listeria monocytogenes, Shigella flexneri and Vibrio cholera [34-39]. The plant possesses multitudinous phytoconstituents similar as flavones, flavans, chalcone, triterpenes and aromatic carboxylic acids. These compounds seem to be responsible for antibacterial exertion of various excerpts of parts of pongamia pinnata.

The seed oil exhibited significant antifungal activity against tested fungi. The maximum inhibition against Aspergillus niger followed Aspergillus terreus and Candida albicans. The pure oil (100%) showed maximum inhibition and a minimum inhibition by 40-45% of extracted oil against all tested fungi. The first antifungal compound isolated from plant is Triperpene 118.

It showed strong antifungal activity against yeast and low activity against molds and no activity against Penicillium notatum [40].

The antimicrobial efficacy of ethanolic extract of stems of pongamia pinnata (PPEE) was carried by agar well diffusion method at concentrations of 250µg, 500 µg, 750 µg and 1000 µg against selective Gram-positive pathogens such as Staphylococcus aureus, Bacillus subtilis, Bacillus megaterium, Enterococcus faecalis, Gram-negative Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Proteus vulgaris and fungi Aspergillus niger. The PPEE possess appreciable levels of tannin and flavonoid contents, 39.7±2.6 mg of GAE/gm and 41.2±1.7 mg of rutin/gm of extract respectively. The plant extract was exhibited maximum activity against Bacillus subtilis followed by E. coli and then against Bacillus megaterium. The plant also exhibited significant activity against Aspergillus niger. The MIC lies between 31.2 to 62.5 mg/ml [41].

Pongamia pinnata as a biofuel

Mature seeds of pongamia have lately gained a great marketable applicabicability owing to their high oil painting content, Pongamia seed canvases are rich in oleic acid, which may endow the biodiesel products with further desirable energy parcels, which is explored as an alternate source of energy. Oil painting yielding crop shops are veritably important for profitable growth of the energy and agricultural sectors. The oil painting seeds containing polyunsaturated fatty acids are important source of biodiesel. These organic seed canvases are better than diesel energies in terms of physicochemical parcels and biodegradability. To increase the biodiesel product is important to have an elite genotype of Pongamia pinnata bearing high oil painting yielding seeds. The seeker plus tree (CPT) is an individual tree of pongamia pinnata enjoying superior morphological characters than other individualities of the same species. Pongamia pinnata has the implicit to give an environmentally respectable energy, the product of which is greenhouse gas neutral, with reductions in current diesel machine emigrations. The seeds of pongamia pinnata contain 30 to 40% oil painting. Which can be converted to biodiesel (adipose acid methyl esters; FAMEs) by esterification with methanol in the presence of KOH [42].

SR. No.	Extract	Method (in vivo/ In vitro model)	Pharmacological activity	Reference
1.	Ethanolic excerpt of leaves	Hyperammonemic rats	Anti-oxidant	43
2	Methanolic excerpt of seed	Hyperammonemic rats	Anti-oxidant	44
3.	Bark and leaf excerpt	Albino rat	Antiprotozoal	45-48
4.	Methanolic excerpt	Rats	Anti-inflammatory	49-51
5.	Ethanolic excerpt	Albino mice	Anticonvulsant	52,53
6.	Ethanolic excerpt	Rats	Anti-hyperammonemic	54
7.	Methanolic excerpt	Human pancreas	Cytotoxicity	55,56
8.	Aqueous excerpt	Rats	Immune modulatory	57

9.	Petroleum ether excerpt	Diabetic rats	Cardioprotective	58
10.	Flower excerpt	Diabetic rats	Anti diabetic	59
11.	Leaves excerpt	Rats	Anti-lice	59
12.	Methanolic excerpt	Rats	Anti- ulcer	59
13.	Leaves excerpt	Rat and mice	Antipyretic	59
14.	Stem bark ethanolic Excerpt	Albino rats	Neuroprotective	59
15.	Methanolic excerpt	Rats	Anthelminthic	59

CONCLUSION

In traditional system of Ayurvedic drug Pongamia pinnata has been extensively used as curative agents for variety of ailments. In the traditional system of drug, such as Ayurveda and Unani, the plant is used for anti-inflammatory, anti-plasmodial, anti-nociceptive, anti-hyperglycaemic, anti- lipid peroxidative, anti-diarrhoeal, anti-ulcer, anti-lice, anti-oxidant, antibacterial, antimicrobial. Its oil is a source of biodiesel. It has alternative source of energy, which is renewable, safe and non-pollutant. 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. The expansive literature check revealed that Pongamia pinnata L. is an important protean medicinal plant with different pharmacological activities. The plant shows the presence of numerous chemical ingredients which are responsible for varied pharmacological and medicinal properties.

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