Research Article

INTERNATIONAL RESEARCH JOURNAL OF PHARMACY
www.irjponline.com
ISSN 2230-8407 [LINKING]

THERAPEUTIC USES OF KARANJ IN VARIOUS DISORDERS

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How to cite: Kinshuk sachdeva, Ananya jaiswal,Mrs. Pooja, Dr.Nakul Gupta THERAPEUTIC USES OF KARANJ IN VARIOUS DISORDERS**.** International Research Journal of Pharmacy, 2025,16:6:47 -67

Doi: http://doi.org/10.56802/irjp.2025.v16.i06.pp47-67

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ABSTRACT

Pongamia Pinnata (karanj) is an ancient plant described in veda, samhita and almost in all Nighantu. It is one of the significant herbal plants with different therapeutic medicinal properties. The oil, leaves and bark of the pongamia pinnata tree have remarkable medicinal properties. While showing the promising therapeutic potential, standardization of the preparations, rigorous clinical trials, and safety profiling remain a critical research priorities. This review aims to bridge the old medicinal knowledge with contemporary pharmacological understanding, highlighting the pongamia pinnata potential in developing novel therapeutic interventions. In costract oil cakes have broad pesticidal applications due to the presence of various bioactive constitutions (e.g., Karanjin and Pongamol). It has an alternative source of energy, which is renewable,safe and non-pollutant. Pongamia pinnata is used in many diseases viz Diabetes, diarrhea, skin disease as scabies. In review article reveals the overall information about the therapeutic use of pongamia pinnata (karanj) in various disorders.

Keywords: Pongamia pinnata, Therapeutic uses, Ayurveda, Disorders

INTRODUCTION:

Karanja [Pongamia pinnata(Linn.) Merr.] is one of the most popular and extensively used herbs in the Ayurvedic Medicine. Medicinal plants plays an important role in the human lives for many years to treat various diseases all over the world. Two species of Karanja viz. Urkara Karanja, (Pongemia globra), Kanta Karanja and Cirivivah Karanja (Pongamia pinnata) have been found in India[1]. Karanj contains Karanjin, pongapin, Karanja chromen. It shows antibacterial, hypoglycemic activity. The essential oil from P.pinnata showed mild antifungal activity. Another importance of Karanja is because of its oil-containing seeds[2].

Indian Traditional system (Ayurvedic) including as digestive, laxative, anthelmintic, to treat piles, wound healing, relieving rheumatic pains, for cleaning and preventing ulcers in gonorrhea and scrofulous enlargement[3] Previous studies have determined that Pongamia pinnata is rich in flavonoids and they are effective to treat these diseases. Anti Hyperammonemic efficacy of the leaf extract was investigated on blood ammonia, plasma urea, uric acid, non-protein nitrogen and serum creatinine in control and ammonium chloride induced hyperammonemic rats. The pinnata seeds contain 40% oil, which can be converted to biodiesel by transesterification method.[4]

Almost all parts of the karanj plant contains medicinal values and are used in the treatment of the various diseases. Other than medicinal uses, the karanj plant is also used in animal fodder or composted timber and fish poison.[5]

Vernacular names:-

1. Sanskrit name:- karanjaka, Naktahva
2. Hindi name:-Karanj, Dithouri
3. Punjabi name:-Sukhchain
4. English name:-Indian Beech
5. Bengal name:-Dahar karanja, Natakaranja
6. Telugu name:-Kanugu, Ganuga
7. Tamil name:-Pongana, Pungai
8. Urdu name:-karanj
9. Malayalam name:-Pungu,Ungu,Unu,Avittal[6]

TAXONOMY:-

Kingdom- plantae
Subkingdom- tracheobionta
Superdivision- spermatophyta

Division- magnoliophyta
Class- magnoliopsida
Subclass- rosidae
Order- fabales
Family- fabaceae
Genus- pongamia
Species- pinnata[7]

Properties and Action(Ayurvedic):-

Rasa : Katu, Tikta, Kasaya
Guna : Tiksna
Virya : Usna
Vipaka : Katu
Karma : Kaphara, Pitthara,Vatahara[8]

Botanical description:-

It is a medium sized evergreen tree, it can grow up to 18m height and 1.5m in girth.

Leaves: 8-10 inch long, pale green oblong or ovate, obtuse or shortly accuminate,2-4 inch long, midrib and lateral nerves rather prominent beneath.

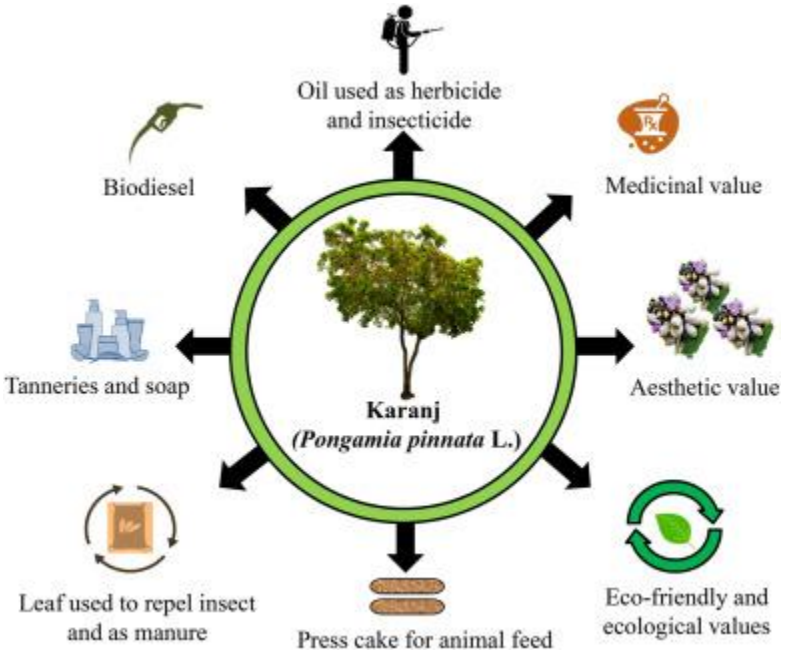
Flowers: in simple peduncle axillary racemes nearly as long as the leaves; nodes tumid bearing 2-4 pedicels; rachis and pedicels sparsely puberulous; pedicels with 2 bracteoles at the base and with 2 others, towards the apex. Calyx widely campanulate, mouth truncate.

Fruit: It is 1-2 inch long with a short decurved point, turgid woody,glabrous,brownish green.

Seeds: 1-2, elliptic, wrinkled, white, marble with brownish lines.
Bark: Thin grey to greyish brown and yellow on the inside.[9]

Geographical distribution:-

It is widely distributed throughout tropical Asia and the Seychelles Islands, south eastern Asia, Australia, India and locally distributed throughout the state of Maharashtra along banks rivers; Very common near the sea coast in tidal and beach forest in Konkan; along decan rivers.[10]



Phytochemical constituents of karanj:

1. **Flavonoids**

- Karanjin: The furanoflavonoid karanjin stands out for its anti-inflammatory functions as an agent against oxidation and ulcer treatment.
- Pongapin: Properties of pongapin works as a germ-fighting agent and anti-inflammatory solution..
- Derrisin: It serves as a healing compound which also acts to protect cells.
- Kanjone: Recognized for its healing qualities.
- Furano-flavones: It belong to the category of other health-promoting flavonoid compounds[11]

2. **Fixed Oils**

- Pongamol: The seed oil contains pongamol which acts as an anti-inflammatory and antioxidant agent..
- Oleic Acid: The saturated fatty acid component Oleic Acid works both as a protective agent and as skin soother..
- Linoleic Acid: The essential fatty acid Linoleic Acid performs two vital functions which include tissue healing and management of inflammatory responses.
- Palmitic Acid: The oil contains stabilizing fatty acid palmitic acid thus maintaining stability.[12]

3. **Alkaloids:** Little amounts of nitrogen-based compounds appear in the meat which supports germ defense and balances stomach acid level

4. **Tannins:** These compounds provide protective barrier formation to the stomach by fighting infections and generate astringent effects that control acid levels.[13]

5. **Sterols**

- β-Sitosterol: This plant-derived sterol has anti-inflammatory and healing properties.
- Stigmasterol: It helps lessen inflammation and supports the integrity of cell membranes.

6. **Glycosides:** Urine production receives support from such minor components along with anti-inflammatory properties.

7. **Saponins**: The components are famous for their protective cell functions and anti-inflammatory capabilities.

8. **Phenolic Compounds:** Polyphenolic compounds demonstrate protective antioxidant behavior while simultaneously helping to fix tissue damage.

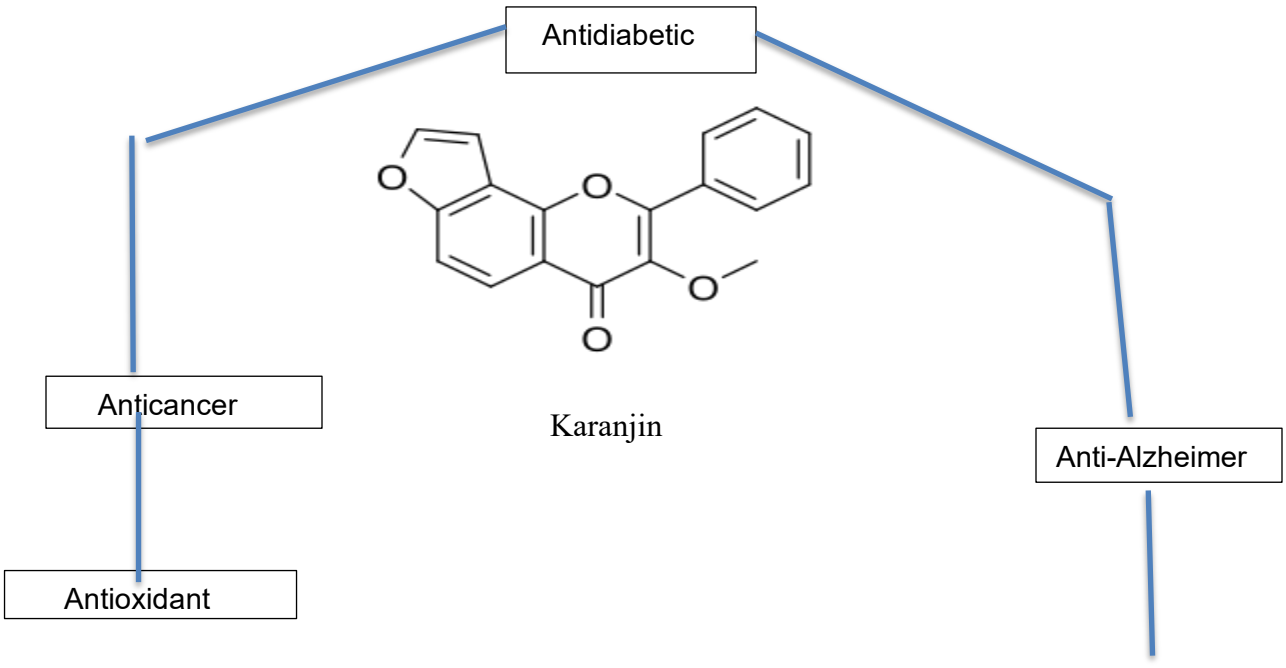
9. **Furanodiketones:** The special compound karanjone stands out because of its biological function which includes guarding against organisms and protecting the body.

10. **Proteins and Amino Acids:** The protein in seeds together with amino acids serve minor therapeutic functions that support healing processes.[14]

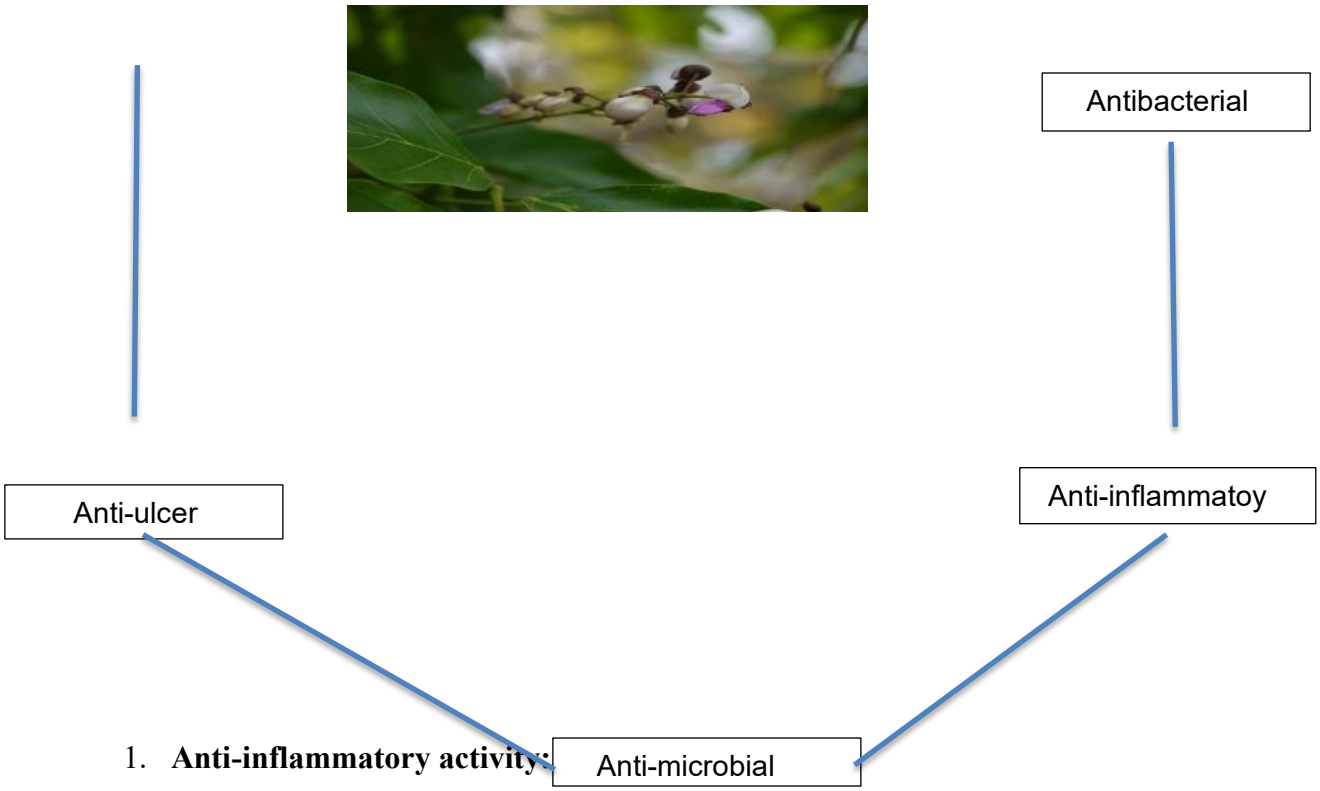
Other Constituents

- Coumarins: Coumarins serve to combat infections by simultaneously alleviating inflammatory symptoms..
- .Quercetin: A strong antioxidant flavonoid.[15]

Pharmacological activity of karanj:



Karanjin



1. **Anti-inflammatory activity:**

This anti-inflammatory effect of Pongamia pinnata (Karanj) emerges from both tested laboratory data and folk traditions.

- Leaves Extract:

Laboratory experiments used a 70% ethanolic leaf extract to discover significant anti-inflammatory properties in rats that did not result in ulceration. Laboratory experiments on albino rats proved that administering either 400 mg/kg or 800 mg/kg effectively reduced carrageenan-induced swelling along with inflammation.

- Seed Oil:

The seed oil compound Karanjachrome presents properties which effectively decrease paw swelling across the entire inflammatory process. Research suggests Karanjachrome affects both inflammatory mediators and peritoneal mast cells and ion channel sensing and prostaglandin pathways.

- Stem Bark Extract:

Albino rats received the stem bark extract to evaluate its capacity against inflammation in different time durations. The experimental data obtained for 400 and 800 mg/kg indicates this substance has potential for treating chronic inflammatory health problems.[16]

- Mechanisms of Action:

The inflammatory reduction effect of karanjin pongamol and other flavonoids constitutes an essential part in mediating this effect. Active ingredients within Pongamia pinnata monitor pro-inflammatory substances and they control cyclooxygenase (COX) and lipoxygenase pathways which leads to decreased inflammation.

Traditional Karanj usage for inflammatory condition treatment finds validation in these research outcomes which demonstrates potential medical applications for the present day.[17]

2. Anti-microbial activity

The medicinal plant Pongamia pinnata otherwise known as Karanj displays significant antimicrobial properties consistently recognized among scientists.

- Antibacterial Effects:

The antimicrobial properties of Pongamia pinnata extracts emerge from solution types that include water when combined with chloroform and ethanol and methanol and petroleum ether. These extracts demonstrate effectiveness against a series of bacterial strains. Scientists recognize the ethanol extract as a standout agent because it displays strong antibacterial activity toward E. coli, Salmonella Typhimurium, Staphylococcus aureus, Klebsiella pneumonia, and Pseudomonas aeruginosa. Research has shown that Pongamia seed oil exerts bacteriostatic effects on two bacterial strains which include S. aureus and Pseudomonas aeruginosa and maintains these inhibitory properties when diluted.

- Antifungal Effects:

Seeds along with leaves of Pongamia pinnata exhibited antifungal properties that inhibited growth of Aspergillus niger and Aspergillus fumigatus. The antimicrobial properties of Pongamia pinnata prevent fungal spore germination which is why they show strong effectiveness against fungal growth.[18]

- Interactions with Antibiotics:

Reasearchers discovered that Pongamia pinnata seed coat aqueous extracts enhance the activity of ampicillin, meropenem and cefotaxime antibiotics when fighting against the antibiotic-resistant bacterium MRSA. The anti-fungal properties highlight productive relationships between drugs which produce minimal drug interactions.

How It Works:

The antimicrobial effects stem from multiple bioactive compounds in Pongamia pinnata plants which include flavonoids, alkaloids, saponins together with phenolic compounds. Microbial growth reduction occurs from bacterial cell wall disruption combined with protein synthesis inhibition and enzyme activity interruption caused by these substances

Research Takeaways:

Deadly microbial organisms show higher sensitivity to Ethanolic extracts than alternative solvents thus making them promising treatment candidates. The antibacterial and antifungal effects of methanolic extracts derived from the bark and seeds show high potential against multiple microorganisms. The antimicrobial properties of karanjin together with pongamol and multiple flavonoid compounds play an important role in these effects. The research demonstrates the prospective value of Pongamia pinnata as an organic antimicrobial agent suitable for additional medical investigations.[19]

3. Anti-ulcer activity: The anti-ulcer potential of Pongamia pinnata (Karanj) comes from its medicinal compounds which support traditional uses in ulcer treatment.

How It Works Against Ulcers:

The seed oil extracted from Pongamia pinnata demonstrates effects that help treat ulcers. The anti-ulcer properties of this plant stem from its three main effects which are inflammation control and stress defense and stomach lining protection. The oil from Pongamia pinnata seed helps to reduce acid levels in the stomach and protect mucosal tissues thus preventing damage caused by acid or other irritating substances.

- Compounds That Matter:

The effects of Pongamia pinnata result from its main compounds including flavonoids, pongamol and karanjin. The active substances examine oxidative stress effectively because this stress mechanism triggers development of ulcers.

- Reducing Inflammation:

- The medicinal plant tends to reduce inflammation of stomach lining tissue that frequently develops with ulcers. The plant prevents inflammatory substances and enzymes from active participation in the bodily processes.[20]

Support for the Stomach Lining:

Ethanolic extracts prepared from Pongamia pinnata leaves and flowers support the stomach lining for defense against ulcers provoked by alcohol and NSAIDs.

- Research Evidence:

Test models confirm that extracts from these plants efficiently reduce observed ulcer scores thus demonstrating their therapeutic effects on gastric ulcers. The medicinal value of Pongamia pinnata to treat ulcers seems promising due to its demonstrated antioxidant property and anti-inflammatory potential which guards the gastric barrier from damage. Modern evidence confirms what traditional Ayurvedic practitioners have practiced for generations regarding ulcers.[21]

4. Anti diarrhoeal activity: Scientific research along with traditional practices demonstrate that the plant material from Karanj (Pongamia pinnata) shows potential in managing diarrhea through its anti diarrhoeal properties. The medicinal compounds within Karanj extracts from leaves and bark such as flavonoids tannins saponins and alkaloids have been proven effective for this medical problem**..**

- What We Know:
- How It Works:

The extracts of Karanj contain high amounts of tannins and flavonoids that help control gut processes while reducing fluid outflow in the digestive system. When combined with food Pongamia extracts produce astringent effects which produce solidier stool consistency.

The toxic bacteria including Vibrio cholerae and E. coli cannot produce their toxins while these compounds prevent bacterial invasion of gut cells.

- Evidence from Studies:

The use of Pongamia pinnata leaf extracts diluted with methanol and ethanol showed effectiveness against diarrhea symptoms during animal research. During a diarrhea test using castor oil on mice the treatment group with Pongamia extracts produced reduced amounts of stools which indicates a positive effect on intestine secretion control.

- Fighting Bacteria:

Bacterial infections caused by E. coli and Shigella can be combated through the antibacterial properties of the extract.

Key Ingredients:

- The flavonoids present in Pongamia extracts act as anti-inflammatory antioxidants that lower stress levels in the gastrointestinal tract.

- Tannins and Saponins together aid heps in restraining both intestinal secretions and bacterial attacks.

- These compounds protect the intestines against damage which occurs due to germ activity.[22]

In Summary:

Two key properties of Pongamia pinnata help treat diarrhea through its actions to control gut motion along with bacterial blocking and inflammation reduction within the digestive system. Scientific studies confirm that ethanolic and methanolic leaf and bark extracts of Pongamia pinnata show treatment potential in diarrhea cases based on its traditional Ayurvedic and folk medicine applications[23]

5. Antioxidant activity: The multiple natural compounds of Karanj such as flavonoids polyphenols furanoflavones and terpenoids make it an effective antioxidant. There are natural compounds in Karanj that defend living organisms by removing free radicals while protecting against oxidative stress. The following text explains the antioxidant mechanism with supporting scientific evidence regarding this functionality.

Key Points on Antioxidant Activity:

- Active Compounds:

The three major antioxidant compounds responsible for free radical defense are quercetin combined with kaempferol and karanjin. Other compounds known as carotenoids and terpenoids enhance the stabilization of reactive oxygen species (ROS) by Moringa oleifera.

Action:

- Free Radical Scavenging: The Karanj leaf and flower extracts prepared with hydro-alcoholic and methanolic solutions possess robust abilities to counteract both DPPH and ABTS radicals.

- Reduction: These extracts show capability to decrease malondialdehyde amounts which protects cell membranes from damage.

These extracts show capability to decrease malondialdehyde amounts which protects cell membranes from damage.[24]

6. Anticancer activity: Anticancer activity in Karanj (Pongamia pinnata) stems from its bioactive compounds which contain karanjin as the main furanoflavonol. Studied research shows karanjin functions as an agent that suppresses cancer cell growth while triggering programmed cell death and delaying cell division patterns.

Mechanisms of Anti-Cancer Activity:

- Cytotoxic Effects:

The substance karanjin demonstrates strong toxic effects toward different cancer cell types including the lung carcinoma A549 as well as the liver carcinoma HepG2 and leukemia cells HL-60.

The MTT assays evaluate cytotoxicity levels and show decreasing cell viability after exposure to increasing concentrations of karanjin.

- Cell Cycle Arrest:

  When exposed to Karanjin treated cells the cell division process stops at the G2/M phase. The cell division and cancer cell propagation becomes blocked by this disruption.

- Apoptosis Induction:

The apoptotic effects of karanjin exist on cancer cells which can be proven through flow cytometry analysis using Annexin V-FITC/PI staining to detect programmed cell death vital for malignant disease elimination.

- Reduction in Oxidative Stress:

The antioxidant elements within pongamol and flavonoids present in Karanj negate the damaging effects of reactive oxygen species (ROS) on the body. Protection of DNA from damage becomes possible due to these inhibitory compounds that lower the risk of cancer formation.

- Supporting Studies

The isolated form of karanjin demonstrates its ability to reduce tumor progression pathways which include angiogenesis and metastasis.

Test results of the cytotoxic assays with particular cancer types demonstrated decreased survival rates among cancer cells as karanjin treatment levels increased.[25]

- Applications

Research demonstrates how Pongamia pinnata displays anticancer properties for multiple purposes:

Scientists use this discovery for developing medication that attacks cancer pathways to treat the disease. The therapeutic value would increase when karanjin works together with current cancer treatments to offer both enhanced effectiveness and decreased side effects.[26]

7. Anti-diabetic activity: Karanj which has its scientific name as Pongamia pinnata demonstrates diabetes management potential through its natural compounds that include Pongamol and Karanjin among other flavonoids and phenolic substances. These elements take a central position in lowering blood sugar while contributing antioxidant advantages.

How It Works Against Diabetes:

- Lowering Blood Sugar:

Academic research indicates that Pongamia pinnata flower and leaf extracts lead to important blood sugar decreases when tested on alloxan-induced diabetic rats. Pongamia pinnata extracts produce blood sugar reduction effects which match those of well-known diabetes drug glibenclamide.

- Fighting Oxidative Stress:

The antioxidant enzymes become more active because Pongamia pinnata fights off oxidative stress

during diabetes development. The extract decreases levels of oxidative damage while reducing lipid peroxidation throughout diabetic health conditions..

- Improving Lipid Levels:

The extracts possess the ability to normalize unbalanced cholesterol and triglycerides and other lipids that occur in diabetic patients.
Modulating Enzymes:

- The natural compounds in Pongamia pinnata effectively slow the digestive enzymes α-amylase and α-glucosidase to control post-meal blood sugar level.

Healing the Pancreas:

Research from Pongamia pinnata stands to indicate that this plant aids pancreatic β-cell regeneration which produces insulin resulting in improved natural insulin production by the body.[27]

Active Ingredients

- Flavonoids: The active ingredient flavonoids demonstrates its anti-inflammatory and anti-oxidative stress properties.
- Phenolic Compounds: Phenolic Compounds in leaves perform two important functions which involve maintaining stable blood sugar levels through stress reduction and improved insulin sensitivity.
- Karanjin and Pongamol: Karanjin together with Pongamol serve as active components which help reduce blood sugar levels in addition to reducing oxidative stress.

Research Findings:

- Ethanolic Extracts: The scientist discovered that giving diabetic rats 300 mg/kg of flower extract extract by ethanol produced substantial reductions in blood sugar markers as well as oxidative stress markers.
- Leaves: Long-term leaf substance use proved beneficial for blood glucose levels through normal and glucose-tolerant models testing.

Mechanism Studies: Scientific research investigating the operational mechanism of the compounds reveals they block carbohydrate enzymes while managing insulin production.

The positive effects of Pongamia pinnata on diabetes treatment and associated complications become more evident through these findings yet human research is needed to support their actual benefits[28]

8. Anti-viral activity: Science has demonstrated that the unique plant compounds present in Pongamia pinnata seeds allow this plant species to destroy viral infections.

Antiviral Actions

- Herpes Simplex Virus (HSV):

Tests have shown that high concentrations of Pongamia pinnata seed extracts stop the spread of HSV-1 and HSV-2 infections at 1 mg/mL and 20 mg/mL strength levels respectively. Research indicates that the seed extracts can potentially prevent viral multiplication which protects cells from damage.

- White Spot Syndrome Virus (WSSV):

The compound bis(2-methylheptyl) phthalate exists in leaf extracts that demonstrate effectiveness against white spot syndrome virus in shrimp populations. Shrimp infected with disease received ethanolic leaf extracts which resulted in an 80% improvement of their survival rate.

Key Compounds:

- The compound Bis(2-methylheptyl) phthalate appears in the leaves to specifically fight WSSV infections.
- The antiviral effects of the plant become stronger because it contains flavonoids and phenolic compounds present all through the plant..

How It Might Work:

- Active compounds from Hydrilla may disrupt viral replication by interfering with the virus replication process.
- Through its extract the plant enhances immune resistance against viral threats.
- The plant protects cells because it contains antioxidants which guard against viral cell damage.[29]

Uses:

- Herpes Treatment: The treatment of herpes cases might become possible through systemic or topical applications of Pongamia pinnata extract.

-Aquaculture: The shrimp farming industry benefits through Pongamia pinnata because it protects against WSSV viral outbreaks.

In conclusion: Research indicates that the properties of Pongamia pinnata hold value as a development platform for antiviral medication aimed at treating HSV and WSSV. Scientists require additional study to convert these observed properties into therapeutic medicines available for clinical use.[30]

Therapeutic uses of karanj:

All parts of Karanj (Pongamia pinnata) have multiple therapeutic benefits that fulfill distinct medical needs.

- Leaves:

The plant components show medicinal value because they cure inflammation while lowering temperature effects and protecting against viruses. Medical indication points towards the usage of leaves to treat diarrhea along with upset stomach and gonorrhea and leprosy and coughs. The natural constituents of this plant combat bacterial infections and invasive parasites and lice as well.

- Flowers:

The flower extracts contribute two functions: they reduce blood sugar levels and provide protection against oxidative damage. Flower consumption benefits patients with bleeding hemorrhoids and the treatment of high ammonia levels found inside the body.

- Seeds:

Patients can use these seeds as treatment for bronchitis and skin problems in addition to their positive effects on hypertension and prolonged fever and anemia treatment. Rheumatism and respiratory illnesses become treatable when utilizing seeds as a remedy. Scientists observe that seed extracts demonstrate potential to decrease inflammation together with enhanced brain function ability.

- Oil (from seeds):

Medical practitioners use this oil to treat scabies along with leprosy and ulcers in addition to persistent fever. The substance contains properties to fight fungi as well as bacteria and worms and ulcers. The substance functions as an environment-friendly alternative fuel because of its biofuel properties.

- Roots:

The roots demonstrate effectiveness in both medical cleaning of ulcers and treating vaginal infections and gonorrhea. The plant extract provides benefits to address both pain management and eliminate parasitic infections.[31]

- Fruits:

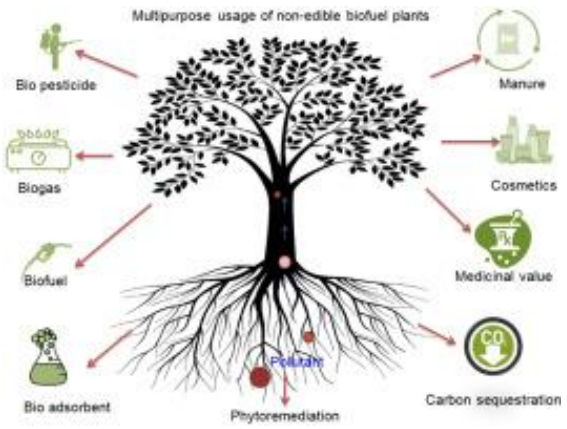
Consuming fruits has the medical potential to manage leprosy alongside women's health problems and abdominal tumors. The compounds found in this plant have two beneficial actions: they destroy parasites and exhibit anti-tumor properties.

- Bark:

The bark offers two beneficial effects by reducing spleen swelling and treating both mental health disorders and bleeding piles. Karanj acts as an effective remedy for combating coughs along with colds and beriberi diseases.

Karanj displays healing properties because it contains multiple valuable compounds like flavonoids, alkaloids, tannins together with active oils. Common health and environment settings benefit from the therapeutic capabilities of karanj which stem from its various beneficial compounds.[32]

Non-therapeutic uses of karanj:



- Biofuel Production:

Biodiesel production utilizes the renewable biodiesel-producing oil obtained from these seed types. The fuel serves the environment better than fossil fuels because it produces less pollution during its operation. Rural residents together with others have adopted this oil to serve as their main energy source.

- Agriculture:

Crops obtain protection by using Karanj seed extract combined with leaves as bio-pesticides and antifungal treatments. The ability of the plant to fix nitrogen makes it an excellent contributor to soil fertility while supporting agroforest systems.

- Wood and Timber:

The wood extracted from Pongamia pinnata serves both structural building purposes and serves as an instrument creation medium and fire combustible material.

- Cosmetic and Industrial Uses:

The excellent cleansing properties of Pongamia pinnata oil make it valuable for manufacturing soaps. The oil finds use in the manufacturing of lubricants.

- Environmental Benefits:

It controls erosion effectively because Pongamia pinnata develops deep roots. The broad foliage serves as protective shade across both city and country landscapes while offering substantial help in reforestation initiatives especially for coastal and salt-resistant environmental zones.[33]

Conclusion:

The evaluation demonstrates Pongamia pinnata (karanja) holds significant worth as an important medicinal plant. Pongamia pinnata (L.) Pierre functions as an essential medicinal plant because of its dual uses for medical applications and ecological conservation. The plant contains numerous beneficial chemicals along with multiple health advantages by functioning as an antioxidant and ant-inflammatory agent and by controlling blood sugars and fighting bacterial infections. Pongamia pinnata demonstrates its worth as biofuel material because it offers a sustainable energy alternative.

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