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A Systemic Review: *Pithecellobium dulce* (Jangal Jalebi)

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Abstract

Pithecellobium dulce (Roxb.) Benth., commonly referred to as Jangal Jalebi, Vilayati Babul, or Manila Tamarind, is a versatile tree in the Leguminosae (Fabaceae) family. It is commonly found in tropical and subtropical areas and is valued for its ecological, medicinal, and nutritional benefits. The plant is rich in a variety of bioactive compounds, including flavonoids, alkaloids, phenols, glycosides, tannins, saponins, terpenoids, and steroids, which enhance its pharmacological potential. Different extracts of P. dulce display a range of beneficial properties, including antioxidant, antimicrobial, anti-inflammatory, antidiabetic, cardioprotective, antifungal, antidiarrheal, and anticonvulsant effects. Both methanolic and aqueous extracts from the leaves and bark have pronounced anti-inflammatory and analgesic properties, whereas extracts from the fruit peel and seeds reveal antioxidant and cardioprotective benefits by lowering oxidative stress and boosting enzyme activity. Its antidiabetic effects stem from the inhibition of the enzymes α-amylase and α-glucosidase, regulation of blood sugar levels, and protection of pancreatic β-cells. The fruit pulp is packed with vitamin C, protein, fiber, and antioxidants, which are beneficial for health. The tree also helps the environment by boosting soil fertility through nitrogen fixation and can grow well in poor or salty soils, highlighting its ecological value. Traditionally, people use P. dulce to treat fever, inflammation, skin issues, diabetes, ulcers, and digestive problems, as well as to support healthy skin and hair. Overall, this plant is an important resource for both medicine and the environment. However, more studies on its chemical properties and clinical effects are needed to identify its active ingredients, determine safe dosages, and confirm its healing abilities.

Keywords: Antidiabetic activity, antimicrobial activity, antioxidant activity, *Pithecellobium dulce*, traditional medicine.

INTRODUCTION

Locally referred to as “Jangal jalebi,” it is also known as “Vilayati babul” in Hindi and “Manila tamarind” in English (Figure 1). This plant is part of the Leguminosae family and is primarily cultivated in India for hedges, street trees, and ornamental purposes because of its attractive leaves and interesting pods. The consumption of wild fruits has declined because of advancements and hybridization in commercial fruits [1]. It has become widespread and well-established in India and tropical Africa, particularly along coastlines. In the Caribbean islands, such as Cuba, Jamaica, Puerto Rico, and St. Croix, as well as in Florida and Hawaii, USA, it is especially invasive, though it tends to be better controlled in areas with higher population and animal activity [2]. The protective properties of bioactive materials primarily stem from plant polyphenols, which possess antioxidant, antimicrobial, antiviral, and anticarcinogenic characteristics. Some benefits of the leaves are:

- Rich in antioxidants.
- Heal wounds and burns.
- Help control diabetes and blood sugar.
- Protect the heart.
- Fight cancer cells.
- Good for skin and hair (used in cosmetics) [3].

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These plant-derived bioactive compounds have enormous potential to treat diseases like diabetes, cancer, inflammation, and other disorders [4].

Figure 1. *Pithecellobium dulce* (Jangal Jalebi).

ENVIRONMENTAL & OTHER ADVANTAGES

- Shade tree – Provides good shade in hot climates.
- Soil enrichment – Roots fix nitrogen, improving soil fertility.
- Drought resistant – Grows well in dry areas.
- Ornamental value – Attractive canopy and fragrant flowers.
- Fodder and fuel – Leaves used as animal fodder; wood used as firewood.

NUTRITIONAL ADVANTAGES

- Fruits are rich in vitamin C, protein, fiber, and antioxidants.
- Seeds and pulps provide energy and essential nutrients.
- Consumed as fresh fruit, chutneys, or in traditional dishes.

ECOLOGICAL DETAILS

- *Habitat:* Thrives in tropical and subtropical climates; grows in dry, coastal, or rocky soils.
- *Soil and Climate:* Tolerates poor, saline, and alkaline soils. Requires warm temperatures and plenty of sunlight.
- *Pollination:* Flowers are pollinated by bees, butterflies, and sometimes bats due to their sweet fragrance.
- *Nitrogen Fixation:* Like other legumes, its root nodules fix atmospheric nitrogen, improving soil fertility and benefiting nearby plants.

COMMON NAME

- *Arab:* Showkat Madras.
- *Bengali:* Dekhani babul.
- *Chinese:* Niu ti dou.
- *English:* Quamachil, Madras thorn, manila tamarind.
- *French:* Campeche (New Caledonia), Cassie de Manille.
- *German:* Camambilarinde.
- *Greek:* Pithekos ellobion.
- *Hindi:* Vilayati babul, Vilayati imli, Jangle jalebi.
- *Japanese:* Huamuche, Guamuche.

- *Javanese:* Asem londo, As am belanda.
- *Kannada:* Seeme hunase.
- *Philippines:* Camachile.
- *Sanskrit:* Kodukkaapuli.
- *Spanish:* Guamuchil, Guama americano, Quamachil.
- *Tamil:* Kodukkaapuli.
- *Thai:* Makham-khong, makham-th
- *Vietnamese:* Me Keo, Keo Tay, Me nuoc, Gang Tay [5].

BOTANICAL DESCRIPTION

- *Domain:* Eukaryota.
- *Kingdom:* Plantae.
- *Phylum:* Spermatophyta.
- *Subphylum:* Angiospermae.
- *Class:* Dicotyledonae.
- *Order:* Fabales.
- *Family:* Fabaceae.
- *Genus:* Pithecellobium.
- *Species: Pithecellobium dulce* [6].

MORPHOLOGICAL DESCRIPTION

As *P. dulce* matures, its grey bark becomes tougher and begins to peel. The leaves measure between 2–2.5 × 1–2 cm and feature two leaflets with kidney-shaped lobules. A slender spine, measuring 2 to 15 mm, is found at the base of each leaf. *P. dulce* also showcases hairy crown flowers and small white heads that are about one centimeter in diameter. The flowers contain 50 sparse stamens enclosed in a joint tubular calyx. The ripe pods are helical in shape, reddish-brown, and measure 10 to 15 × 1.0 cm [7].

PHYTOCHEMICAL REVIEW [5]

- Leaves.
- Fruit.
- Seed.
- Peel.
- Tree.
- Root.

PHARMACOLOGICAL ACTIVITY [7]

- *Antimicrobial Activity:* The antimicrobial effects of hexane, ethanol, benzene, and ethyl acetate extracts from the plant were assessed using the disc diffusion method against Enterobacter aerogenes, Klebsiella pneumoniae, and Acetobacter aceti. The results indicated that the pod pulp extract was potent against both gram-negative Klebsiella pneumoniae and gram-positive Bacillus subtilis. Notably, B. subtilis exhibited a greater clearance diameter compared to other gram-positive bacteria.
- *Analgesic and Anti-Inflammatory:* The methanolic extract of *P. dulce* leaves at doses of 200 and 400 mg/kg demonstrated significant analgesic and anti-inflammatory properties. It was most effective three hours post-administration for both doses, outperforming standard medication.
- *Antioxidant Activity:* Different laboratory tests, like DPPH, nitric oxide, hydroxyl, superoxide, and lipid peroxidation, were done to check the antioxidant power of *P. dulce* water and methanol extracts. The extracts had a high phenolic compound content, which may be the reason for their strong antioxidant effect. Both extracts showed good free radical fighting activity, which increased with higher concentrations.
- *Anticonvulsant Activity:* The ethanol and water extracts of *P. dulce* bark were tested in rats for antiseizure effects. Both reduced seizures, but the water extract worked best, like the epilepsy drug

phenytoin. Leaf extracts also affected movement and coordination, showing strong action on the brain and nerves.

- *Cardioprotective Activity:* Scientists examined the fruit peel extract of *P. dulce* on rats that had heart damage from isoproterenol. The ethanolic extract helped improve heart health by boosting important heart enzymes (SGOT, SGPT, CPK, and LDH).
- *Antitubercular Activity:* The antitubercular activity of *P. dulce* leaf extracts (hexane, chloroform, and alcohol) was tested. The chloroform extract showed moderate effect, while the alcohol extract was most effective at 20 mg/ml, giving results close to standard TB drugs.
- *Antidiabetic Activity:* In rats made diabetic with alloxan, the hydroalcoholic extract of *P. dulce* bark (400 mg/kg) showed strong antidiabetic effects like glibenclamide. Methanol extract of defatted seeds gave a saponin-rich fraction, which was safe up to 2000 mg/kg and helped control blood sugar in a sucrose test. Bark and leaves also blocked α-amylase and α-glucosidase enzymes, slowing starch breakdown and sugar absorption, which helps control post-meal blood sugar.

THERAPEUTICALLY ACTIVITY

- *Anti-Inflammatory Activities: Pithecellobium dulce* leaves have strong anti-inflammatory effects. In laboratory tests, the ethanol extract worked better than aspirin in stopping protein damage and protecting cell membranes. The plant contains helpful compounds like alkaloids, flavonoids, glycosides, phenols, steroids, tannins, terpenoids, and saponins. In rat tests, both ethanol and water extracts reduced swelling in paws. The water extract worked even better than the ethanol extract and was like the medicine diclofenac [5].
- *Antibacterial Activities:* The ethanolic extract of *Pithecellobium dulce* pod pulp can fight both gram-positive bacteria (like Bacillus subtilis) and gram-negative bacteria (like Klebsiella pneumoniae) because it contains flavonoids and saponins. Fruit peel extracts (water, methanol, and ethyl acetate) also kill eight types of wound-causing bacteria, including Staphylococcus aureus, E. coli, and Pseudomonas aeruginosa, with the methanol extract working best.
- *Antifungal Activities:* The extract from *Pithecellobium dulce* exhibited significant antifungal properties. The minimum inhibitory concentration (MIC) was found to be 0.62 mg/ml for Aspergillus fumigatus and 1.25 mg/ml for Aspergillus niger, comparable to the effects of amphotericin B. Additionally, researchers identified a lysozyme (a type of protein) from the seeds of *P. dulce* with a molecular weight of 14.4 kDa, which is quite like the chicken egg lysozyme at 14.3 kDa. This plant-derived lysozyme demonstrated antifungal activity against Macrophomina phaseolina and remained stable at 80°C for 15 minutes at pH 8.0 [5].
- *Antidiabetic Activity:* Diabetes mellitus results from insulin-related issues, resulting in elevated blood sugar levels. Common diabetes medications may have side effects, including potential damage to the liver or kidneys. Natural plant-based treatments present a safer alternative. One such plant is *Pithecellobium dulce*. Research on its seed extract in diabetic rats showed it could protect insulin-producing cells. Rats that received the extract exhibited improved blood sugar regulation and increased liver glycogen levels. Additionally, the fruit contains pinitol, a natural substance known for its antidiabetic properties [4].
- *Cardioprotective Activities:* Research indicates that ethanol and water extracts from the fruit of *Pithecellobium dulce* can safeguard the heart in rats suffering from isoproterenol (ISO)-induced heart damage. ISO elevated the levels of specific enzymes (SGOT, SGPT, CPK, and LDH), indicating heart and liver injury. However, the application of *P. dulce* fruit peel extracts resulted in a reduction of these enzyme levels and enhancement of heart health. Notably, the water extracts derived from the fruit and flowers were particularly effective in mitigating heart damage. These plant extracts demonstrated efficacy comparable to verapamil, a well-known heart medication [5].
- *Antidiarrheal Activities:* The ethanolic extract of *P. dulce* demonstrated an antidiarrheal effect in mice induced with castor oil. Loperamide, a standard anti-diarrheal medication, was used for comparison. The phytochemicals present in *P. dulce* can prolong the latent period, postpone, and reduce the frequency of bowel movements [4].

MEDICINAL USE [8]

- Anti-inflammatory/Antibacterial.
- Antioxidant.
- Skeletal/Anti-inflammatory.
- Antiulcer.
- Antidiabetic/Fruit.
- Anthelmintic/Leaves.
- Antibacterial.
- Antimicrobial.
- Hypolipidemic.
- Antituberculosis/Antimicrobial.

TRADITIONAL USES [9]

- Works as antiseptic.
- Lightens skin.
- Prevents hair loss.
- Treats oily scalp.
- Aids weight loss.
- Good for pregnant women.
- Treats fever.
- Cures malaria.
- Regulates blood circulation.
- Controls blood sugar levels.
- Relieves inflammation.
- Cures mouth ulcers.
- Prevent cancer.
- Eliminates pigmentation.
- Cures acne and pimples.
- Removes dark spot.
- Natural skin moisture.

HEALTH BENEFITS [10]

- Works as Antiseptic.
- Lightens Skin.
- Prevents Hair Loss.
- Treats Oily Scalp.
- Aids Weight Loss.
- Good for Pregnant Women.
- Treat Bilious Disorders.
- Treats Fever.
- Cures Malaria.
- Treats Jaundice.
- Regulates Blood Circulation.
- Controls Blood Sugar Levels.
- Boosts Immune System.
- Relieves Inflammation.
- Cures Mouth Ulcers.
- Prevents Cancer.
- Eliminates pigmentation.
- Cures Acne and Pimples.

- Removes Dark Spot.
- Natural Skin Moisturizer.
- Used to treat Venereal diseases (sexually Transmitted Infection).
- Leaves Remedy for indigestion.
- Bark curative for bowel movement/constipation.
- Manila tamarind is also prescribed for diabetics.
- High in diet C which contributes to the antioxidant properties.

Reported Human Health Benefits and Disease-Preventive Properties are given below in Table 1.

Table 1. Reported human health benefits and disease-preventive properties.

Potential benefits	Evidence/active compounds	Health conditions may help prevent
1. Antioxidant	Phenolics, flavonoids, vitamin C	Helps protect against oxidative stress, a risk factor for cancer, heart disease, and premature aging.
2. Anti-diabetic	Saponins, flavonoids	Helps lower blood glucose, improves insulin sensitivity; preventive for type 2 diabetes.
3.Cardioprotective	Polyphenols, potassium	May reduce blood pressure, protect against atherosclerosis and heart damage.
4. Antimicrobial	Alkaloids, tannins	Inhibits bacteria and fungi that cause skin infections, wound infections, and oral diseases.
5. Anti-inflammatory	Flavonoids, terpenoids	Reduces inflammation, helping to prevent or alleviate arthritis, gastritis, chronic inflammatory disorders.
6. Hepatoprotective	Antioxidant compounds	Protects liver from chemical- or alcohol-induced damage.
7.Anticancer (experimental)	High phenolic content	In vitro studies show inhibition of some cancer cell lines (needs clinical confirmation).
8.Anti-ulcer	Tannins, saponins	Protecting stomach lining may help prevent gastric ulcers.
9.Anti-hyperlipidemic	Saponins, fiber	May lower cholesterol and improve lipid profile.

CLINICAL SIGNIFICANCE

- *Antidiabetic Activity:* Leaf and bark extracts inhibit enzymes, like α-amylase and α-glucosidase, helping to lower blood sugar levels. May support management of type 2 diabetes.
- *Antioxidant Activity:* Rich in phenolics and flavonoids. Protects cells from oxidative stress, reducing the risk of chronic diseases like cancer, heart disease, and neurodegeneration.
- *Anti-Inflammatory and Analgesic Activity:* Leaf and bark extracts reduce inflammation and pain, which can be clinically useful in arthritis, injuries, or inflammatory diseases.
- *Antimicrobial and Antifungal activity:* Effective against bacteria (Staphylococcus aureus, E. coli, Pseudomonas, etc.) and fungi. Shows potential in treating skin infections and respiratory infections.
- *Antitubercular Activity:* Alcoholic leaf extract shows inhibitory effect against Mycobacterium tuberculosis strains. Could be a supportive candidate in TB management research.

CONCLUSION

Pithecellobium dulce is a perennial tree in the Leguminosae family that has been widely used in traditional medicine for treating various ailments in both humans and animals. Studies suggest that this plant contains numerous chemical compounds with potential medicinal and therapeutic applications, although further research is needed. Exploring its phytochemical profile is crucial for determining which compounds are responsible for its effects. Existing research supports its traditional uses and indicates that further investigation could lead to the creation of beneficial medicinal products from this plant. Multiple studies have examined the pharmacological properties and effective dosages of *Pithecellobium dulce* extract. This review article summarizes the findings on its biological activity and concludes that *Pithecellobium dulce* holds significant potential for treating a range of conditions and diseases.

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