INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: https://www.ijpsjournal.com

Review Article

Pharmacological Potential of Pithecellobium Dulce Leaves: A Comperehensive Review

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ARTICLE INFO

Published: 12 Sept 2025
Keywords:
Phytoconstituents, Inflammation, Flavonoids, Anti-ulcer, Anti-diabetic.
DOI:
10.5281/zenodo.17106906

ABSTRACT

Many plant species containing the substance of medicinal values have yet to be discovered. The therapeutic values of plant lie in certain bioactive compounds that exhibit the specific biological effect on the human body. In most developing countries traditional medicine & medicinal plants widely contributing as a therapeutic agent. Pithecellobium dulce is regarded as one such plant which have remarkably wide range of therapeutic activities. This tree is originally native to the Americas and is now cultivated widely across India, particularly in the Andaman region. The tree composed multiple chemical constituents like alkaloids, glycosides, flavonoids, steroid saponins. The main compounds present in leaves reported include cyclitol, dulcitol, octacosanol, kampferol-3-rhamnoside and quercetin. The leaves of the plant have been used to manage fever, intestinal problems, infections, tooth ache and ear ache. Furthermore, it reveals the significant activity against the diabetes, diarrhea, inflammation, fungal infection, bacterial infection, oxidative stress, hyperlipidemia etc. It holds a significant position in traditional healing. supernatural fruit of the herbal medicine. The current review is intended to highlight the pharmacological & therapeutic significance of Pithecellobium dulce leaves from research literature evidence

INTRODUCTION

From rural to modern cities. The use of herbal remedies is continuously increasing more attention. Pithecellobium dulce an persistently green, average-sized, thorny plant, and nearly every organ of it is recognized for its medicinal therapeutic value. Pithecellobium dulce (P. dulce) is a native plant of Tropical America and it is mostly cultivated throughout India and some other countries[1]. The Genus Pithecellobium has nearly 19 species in which dulce species have more

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Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

therapeutic as well as pharmacological value[2]. Pithecellobium dulce plant is called by different names in different languages such as "Jungal jalebi" in Hindi, "Seemantha" in Kannada, "Kodukkapuli" in Tamil. Various part of the tree is utilized in folk medicine. Because it containing a bioactive phytochemical such as saponin, tannins, terpenoids, flavonoids & alkaloids etc., it was found that the tree is medicinally active. The parts of this tree have antioxidant, anti-inflammatory, antimicrobial, antidiabetic, cardioprotective, antidiarrheal, as well larvicidal and ovicidal activities[3]. The leaves of Pithecellobium dulce having most valuable therapeutic benefits. The extract of the leaves is employed as remedy for indigestion and To prevent spontaneous abortion & for gall bladder ailments and to treat and both open and closed wounds[4].

Morphology of *Piethecellobium dulce* leaves

The leaves measuring about 2 - 2.5cm long and 1-2 cm wide, with leaflet that are kidney-like in form. occurring in pairs. Each leaf has 2 - 15 mm, thin spine at the leaf base[2]. Leaves have stipules (~5 mm), mostly spiny near inflorescence.

Petioles: 1.2 - 5.7 cm long,

Pinnate 2 per leaf with rachis 8 - 13 (-17) mm.[5] P. dulce is a highly applaud plant in the folk system of treatment because of its valuable nutraceutical and pharmacological properties.[3] This review discusses the phytoconstituents and pharmacological potential of Pithecellobium dulce leaves.

Fig 1. Showing *Pithcellobium dulce* tree and leaves

2. Plant profile:

2.1-Biome

Pithecellobium dulce thrives in arid, shrubby or thinly wooded plains and hillslopes, frequently occurring in costal bushlands. Commonly cultivated at elevation ranging from sea level to about 500 m.[2]

2.2 Plant's Taxonomy[6]

- Botanical name : Pithecellobium dulce benth leaves
- Kingdom : Plantae
- Division : Tracheophyta
- Class : Eudicots
- Order : Fabales
- Family : Fabaceae
- Sub family : Viridiplantae
- Genus : pithecellobium
- Species : P.dulce
- Partused : leaves

2.3 Chemical constituents of Pithecellobium dulce leaves

Leaves yields querectin, kaemferal, dulcitol and afzelin.

GC-MS study of the leaves yielded bioactive constituents: phytol, anthracene, 9(3butenyl), diisooctyl phthalate, 13-docosenamide, 3,6,9-triethyl 3,6,9trimethyl formic acid, cyclotetrasiloxane, octamethyl, 1(+) ascorbic acid 2,6dihexadecanoate.[4]

3. Medicinal properties of Pithecellobium dulce leaves

Leaves extract of Pithecellobium dulce plant possesses multiple pharmacological activities including:

Antidiabetic, Antihyperlipidemic, Antidiarrheal, Antioxidant, Anti-inflammatory, Antifungal, Antibacterial, Anti-ulcer, Locomotory Activity Larvicidal and Adulticidal Activity.

3.1 Anti-Diabetic Activity

Diabetes mellitus is a most common type of endocrine disorder occurs because of insufficient insulin secretion which leads hyperglycemia.

In earlier studies proved that the regular administration of Pithecellobium dulce leave extract about 21 days remarkably reduces the blood glucose level as compared to the control group when an experiment is conducted in the rats.[7]

Further treatment with P. dulce fruit extract (300 mg/kg body weight/day) for 30 days in diabetic rats produced decreases the blood glucose level, Glycated hemoglobin, urea & creatinine. The result of the present study indicates that the fruit extract is non-toxic and possess antidiabetic nature.[8]

Presence of the phytoconstituents like alkaloids, carbohydrates, glycosides, saponins, sterols, tannins, proteins, flavonoids & phenolic compounds in alcoholic extracts of barks of P. dulce shows/possess the antidiabetic activity.[9]

3.2 Anti – diarrheal

Variation happens in the movement of bowel during diarrhea condition. The disease can be easily identified by features of such as increased water content, amount and excretion of fecs. P. dulce possesses medicinally active substance which is responsible for the anti–diarrheal properties. The extracts of P. dulce reduces the defecation rate and moisture of feces when comparison with the control group when an experiment is conducted on Wistar albino rats.

The present anti–diarrhoeal activity done by using the aqueous & ethanolic extract by using the leaves of Pithecellobium dulce, by using Ricinoleic acid-caused diarrhea model in wistar test rats. This study reveals aqueous extract shows more remarkable activity when compared to ethanolic extract at the level of test dose.[10]

The outcomes reveals that treatment with hydrophilic preparation of P. dulce shows remarkable decrease. The P. dulce also possess the strong antidiarrhoeal activity.[11]

3.3 Anti-fungal Activity

Diseases by the pathogenic fungus possess a severe threat to human health and are one of the major leading reasons for illness and death rates globally. The allopathic (or) synthetic drugs which are act as antifungal drugs such as Amphotericin-B having a many adverse effects selected with their body organ dysfunctions (like liver & kidney dysfunction).

P. dulce is extensively employed in folk medicine. The extract of P.dulce was potent on A. fumigatus and Aspergillus Niger etc. with the data from the studies. The leaves extract was prepared depending on the nature of solvents such as hexane, chloroform, acetone, methanol & water.

The screening of phytochemical composition and MIC were examined for effectiveness against the targeted fungus.

Preliminary screening of phytoconstituents from the leaf extract by using water & methanol as a solvent showed the existence of terpenoids & alkaloids, flavonoids were found in water, methanol. The study shows that alkaloids & terpenoids are responsible phytochemicals for the antifungal activity because of presence of free hydroxyl groups.

Both the fungi (A. fumigate & A. Niger) were screened for MIC against stock solution of plant extraction (200 mg/ml).The methanolic extract of the Concentration 12.5 mg/ml was suppressed the visible growth of fungus. So, the study conclude P. dulce represents an economical safe alternative to treat common infectious disease.[12]

3.4 Anti-oxidant Activity

Oxidative stress occurs due to unstable molecule and labile oxygen species is corresponding with numerous ailments. Various numbers of studies have been conducted worldwide to notice the many natural antioxidants present in plant source. [13]

The reactive radicle causes visceral damage, and causes multiple medical issues. Nitric oxide, hydroxyl and superoxide radicals are the few common free radicals which is responsible for some autoimmune diseases like rheumatoid arthritis & diabetes mellitus.[14]

Plants consist a phenolic and flavonoid compounds have been shown to have strong antioxidant activity.[13]

The P. dulce leaves have a capability to show the antioxidant activity against free radical.[14]

The antioxidant potential of methanol and acetronitrile extracts of P. dulce was performed by utilizing DPPH and hydrogen peroxide neutralizing activity and by using the phosphomolybdenum assay conduct chiefly the total antioxidant activity.

Acetronitrile leaf extracts exhibit 93% suppression of DPPH unstable species monitored with 200 µg/ml.

Both extracts demonstrated notable inhibition of hydrogen peroxide at a concentration of 200 µg/mL, with inhibition percentages of 83 % and 80 %, respectively. Previous studies have also evaluated the antioxidant potential of P. dulce aqueous leaf extract, reporting promising results. In the present study, the methanolic and acetonitrile extracts of P. dulce showed significant antioxidant activity, confirming their potential as effective free radical scavengers. The plant extract is an important natural source of antioxidant that may help to decrease the effects of many oxidative stressors.[15]

3.5 Anti hyperlipidemic

Several Hypercholesterolemia acts as a major cause of cardiovascular disease (CVD) with considerable evidence from research that validates this declaration. If left untreated, hypercholesterolemia can lead to atherosclerosis. [16]

The lifestyle of people concern with western food is either it consists of too much energized material & high-fat compound. these too induces the free

radical generation with increased complication CVD. The currently available standard lipid-lowering allopathic drugs showing various side effects. So, researchers are continuing research towards natural phytoconstituents.[17]

Leaf extract from P. dulce contains phytonutrient such as phytosterol, polyphenols & flavonoids. With increase doses, extract combined with usual reference medicine atorvastatin the leaves of total cholesterol (TC), triglyceride (TG), low density lipoprotein (LDL) and very low-density lipoprotein (VLDL) were significantly decreased. When extract was compared anti-hyperlipidemic control It was found to have consequentially enhanced HDL - (70–78%) significantly decreased enhanced TC (47.03%),TG (47.51%),LDL (41.69%) and VLDL (48.60%).[18]

3.6 Anti-inflammatory

The word anti-inflammatory means the property of a substance or treatment that reduces inflammation or swelling (i.e., redness, pain, heat in inflammation).[2]

Many specific drugs used against inflammation, like aspirin, ibuprofen etc among majority of individuals across all the globe. Some adverse effect like stomach ulcer, gastric erosions, severe hemorrhage are caused due to long term usage of NSAIDs drugs (i.e. non-steroidal anti-inflammatory drugs).[19]

The methanol extract of Pithecellobium dulce leaves evaluated for analgesic and anti-inflammatory effect at the dose of 200 and 400 mg/kg body weight. The maximum anti-inflammatory response was produced at 3hours with extract doses of 200 and 400 mg/kg.[20]

3.7 Locomotor activity

Earlier studies on locomotor activity using aqueous and alcoholic extracts of P. dulce leaves demonstrated that these extracts possess marked central nervous system depressant effects, along with hypnotic and skeletal muscle relaxant properties in albino mice.

At the dose 100 mg/kg – the aqueous & alcoholic extract of leaves P. dulce reveals 93.3 % & 63.3 % CNS depressant activity respectively.

CNS depression effect both extracts because enhance the concentration of GABA in brain. Both extracts produce reduction in spontaneous motor active & this effect may be contributed to CNS depressant, as depress of Locomotor activity is common to most neuroleptics.[21]

3.8 Anti-bacterial Activity

The use of herbal plants and their extracts have been used by all over the world for its many biological activities.[19] Pithecellobium dulce is used as traditional medicine. Pithecellobium dulce extract has been analyzed for its evaluation the activity against antibacterial activities.[22]

The P. dulce extract has been studied against the Streptococcus pyrogenes, Escherichia coli. Ethanolic leaf extracts of P. dulce were tested by employing the well diffusion method against gram positive bacteria S. pyrogenes & S. aureus and against gram negative bacteria E. coli & K. pneumonia.

All the test extracts reveal significant antibacterial activities in a concentration-dependent way. The findings were comparison with Gentamycin, a known antibiotic (antimicrobial agent). In this study, the ethanolic extract of P. dulce shows MIC at 60µl conc. Shows 12mm growth of inhibition against S. aureus, 11mm growth of inhibition against S. pyrogenes, 11mm growth of inhibition

against E. coli & 12mm growth of inhibition against K. pneumonia. Hence the study concluded that the ethanolic extract of P. dulce has a potential to shows the antibacterial activity.[19]

3.9 Anti-ulcer Activity

Peptic ulcer disease is a significant chronic gastro-intestinal disorder occurs because of increasing in the secretion of gastric acid and pepsin.[23] A potential medicinal tree. Peptic ulcer disease is also occurred because of anti-inflammatory drugs unhealthy nutritional patterns, pain relieving agents which can damage the stomach lining and cause ulcers. The formation of ulcers is associated with oxidative stress due to excessive secretion of HCl and production of pro-oxidants.

The increased secretion of gastric acid caused mainly by H+, K+, ATPase mechanism. Omeprazole, Lansoprazole, Pantoprazole, Ranitidine & famotidine are the important H+, K+, ATPase inhibitors used to treat the ulcer and these drugs controls the acid secretion; But these anti-secretary medicines produce some adverse side effect on the human body.[24]

Ethanolic leaf extract of P. dulce was evaluated for its ulcer-protective action using a pyloric ligated rat model. A study reveals that the alcoholic extract of P. dulce leaves decreases the amount of gastric juice by 24%, while Ranitidine decreases its by 36%.

The acidity level was also decreased from 4.53 ± 0.007 to 6.67 ± 0.005 by using alcoholic extract of P. dulce, while, ranitidine adjusted the pH to neutral level.

The presence of flavonoid compounds in the extract may be involved for this activity.[25]

The flavonoids have been reported to exhibit the significant anti-ulcer activity in many experimental models of gastric & duodenal ulceration.[26]

The experiment result concludes that the P. dulce leaves extract have a potential to show the anti-ulcer activity in pyloric ligated ulcer model in rats.[25]

3.10 Larvicidal and Adulticidal Activity

Vector-borne diseases pose a major economic and health challenge worldwide, as they reduce productivity and contribute to significant financial losses, particularly in tropical and subtropical regions. No part of the world is entirely free from these infections. Among the vectors, mosquitoes play a dominant role in transmitting illnesses such as malaria, dengue, yellow fever, schistosomiasis, giardiasis, and Japanese encephalitis, which collectively account for millions of deaths every year. In addition, mosquito bites can trigger allergic responses in humans, ranging from localized irritation to more severe systemic effects like angioedema. Plant-based approaches are being explored as alternative mosquito control strategies. For instance, methanolic extracts of Pithecellobium dulce leaves have been tested under laboratory conditions against early larval stages of Anopheles stephensi and Aedes aegypti, showing notable larvicidal activity and potential as an eco-friendly vector control measure.

The methanolic leaf extract demonstrated a concentration-dependent reduction in egg hatchability. As the extract concentration increased, the proportion of hatched eggs declined correspondingly, and at higher doses, hatching was completely inhibited.

3.11 Adulticidal Activity

The study evaluated the adulticidal toxicity of various solvent extracts of Pithecellobium dulce

against Aedes aegypti and other dengue vectors. Among the tested solvents, the ethanolic extract of young leaves showed the highest activity. The LC_{50} and LC_{90} values of the leaf extract against Ae. aegypti adults were 218.64 and 257.99 mg/L, respectively, while no mortality was recorded in the control group [29].

CONCLUSION:

In this study we have prospect & determine the pharmacological potential of Pithecellobium dulce leaves. It exhibits a significant ability for promoting health and controlling diseases. We conclude usage of Pithecellobium dulce as a medicine is safe than the allopathic medicine for respective diseases due to the presence of side effect of allopathic medicine. We have sum up the pharmacological properties of the P. dulce leaves such as antidiabetic, anti-hyperlipidemic, anti-diarrheal, antioxidant, anti-inflammatory, anti-bacterial, antifungal, locomotor activity, anti-ulcer activity & larvicidal & adulticidal activity. Because of occurrence of phytochemicals in the plant leaf extract. Investigation of phytochemicals proves that plant leaf extract as efficient pharmacological properties. Therefore, the leaves of the P. dulce have potential application in controlling several serious disorders. Nevertheless, additional research is still necessary in the upcoming to uncover its further medicinal application.

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HOW TO CITE: Tejashwni P, Manoj G, Rudresh Erappa Havanur, Sharath K S, Afsar Bhasha D, Sangam Yadav, Pharmacological Potential of Pithecellobium Dulce Leaves: A Comperehensive Review, Int. J. of Pharm. Sci., 2025, Vol 3, Issue 9, 1344-1352. https://doi.org/10.5281/zenodo.17106906