Pharmacogn. Res., 2027; 19(1):10-20.
https://www.phcogres.com

Review Article

Phytochemical and Pharmacological Potential of *Pithecellobium dulce*: A Review

Sivasubramanian Piramanayagam*, Sakthi Puvisha Muthu, Elango Gopalan, Cibi Veeramani, Shalini Balraj, Ragavi Sivakumar, Pushparam Asaithambi

Department of Pharmaceutical Chemistry, SNS College of Pharmacy and Health Sciences, SNS Kalvi Nagar, Coimbatore, Tamil Nadu, INDIA.

ABSTRACT

Pithecellobium dulce (Roxb.) *Benth* is a medicinal plant that is commonly used in traditional medicine and its phytochemical profile has shown to contain numerous bioactive compounds which are characterized by the presence of high concentration of flavonoids (42-57 mg QE/g), phenolics (30-75 mg GAE/g), tannins, alkaloids, saponins, sterols and terpenoids. These ingredients together contribute to the wide phytochemical properties. Quantitative tests showed strong antioxidant activity (DPPH radical-scavenging activity of 70-85%, IC_{50}=18-42 µg/mL). The anti-inflammatory activity shows approximately 63% inhibition of protein denaturation, and antidiabetic shows about 40-68% inhibition of α-amylase. Neuroprotective studies show a reduction in oxidative stress and an increase in neuronal viability, and antimicrobial studies reveal 8-18 mm inhibition zones against standard pathogens. These results highlight the multi-targeted therapeutic effect of *P. dulce*, which could be mainly attributed to its phenolic and flavonoid-rich composition. However, although of great interest the available evidence is hampered by inconsistent extraction methods and a dearth of mechanistic and toxicological analysis. This review serves as a legitimate source of reference in favouring the upcoming phytopharmacological studies by compiling the authenticated scientific evidences.

Keywords: Enzyme Inhibition Assays, Metabolic Modulation, Neuroprotection, Oxidative Stress Attenuation, Phytoconstituents.

Correspondence:
Mr. Sivasubramanian Piramanayagam
Department of Pharmaceutical Chemistry, SNS College of Pharmacy and Health Sciences, SNS Kalvi Nagar, Coimbatore-641035, Tamil Nadu, INDIA.
Email: yuccasiva@gmail.com
ORCID: 0009-0008-4481-1901

Received: 22-06-2026;
Revised: 03-07-2026;
Accepted: 18-08-2026.

INTRODUCTION

Pithecellobium dulce is renowned for its strong pharmacological and therapeutic potential and is rich in bioactive compounds, including alkaloids, terpenoids, flavonoids, tannins, and saponins (Shukla *et al*., 2024). Traditionally used in folk medicine, various parts of the plant exhibit diverse medicinal properties, such as antioxidant, anti-inflammatory, antibacterial, antidiabetic, cardioprotective, antidiarrheal, larvicidal, and ovicidal activities, as demonstrated in preclinical studies, primarily involving animal and *in vitro* models (Dhanisha *et al*., 2022).

METHODOLOGY

The present review was undertaken to compile and critically evaluate the available literature on the phytochemical composition, traditional uses, and pharmacological activities of *Pithecellobium dulce*. Relevant scientific publications were retrieved from internationally recognized electronic databases, including PubMed, Scopus, ScienceDirect, Web of Science, and Google Scholar. The literature search was performed using combinations of keywords such as "*Pithecellobium dulce*", "ethnomedicinal uses", "phytochemistry", "bioactive compounds", "pharmacological potential", "antioxidant", "antidiabetic", "hepatoprotective", "antimicrobial", "antivenom", and "hypolipidemic activity".

Peer-reviewed research articles, review papers, and relevant book chapters published in English up to 2025 were considered. Studies describing the taxonomy, botanical characteristics, traditional medicinal applications, phytochemical constituents, and biological activities of *Pithecellobium dulce* were included in the review. Additional references were identified through manual screening of the bibliographies of selected articles to ensure comprehensive coverage of the available evidence.

The retrieved literature was critically evaluated and categorized according to major themes, including botanical description, ethnomedicinal significance, phytochemical profile, and pharmacological properties. Findings from *in vitro, in vivo*, and preclinical investigations were synthesized to provide an updated overview of the therapeutic potential of *Pithecellobium dulce*. Duplicate records, non-peer-reviewed sources, and studies with insufficient scientific information were excluded from consideration.

OPEN ACCESS

Manuscript TECHNOMEDIA

DOI: 10.5530/pres.20270005

BOTANICAL DESCRIPTION

Taxonomical and morphological description

Pithecellobium dulce is native to Tropical America and is an evergreen, thorny tree widely cultivated in India. It belongs to a genus comprising 19 species and is commonly known as Jungle Jalebi in Hindi, Seemantha in Kannada, and Kodukkapuli in Tamil (Murugesan *et al*., 2019). The mature tree possesses hard, flaking grey bark, kidney-shaped lobules, and paired leaflets. Each leaf bears a thin spine measuring approximately 2-15 mm, while the leaflets are about 2-2.5 × 1-2 cm in size. The plant produces hairy crown blossoms with small white flower heads of about 1 cm and flowers characterized by a tubular calyx enclosing nearly 50 stamens. Upon ripening, the spiral pods, measuring approximately 10-15 × 1 cm, turn reddish-brown in colour (Srinivas *et al*., 2018).

- Botanical Name: *Pithecellobium dulce* Benth.
- Kingdom: Plantae.
- Division: Tracheophyta.
- Class: Eudicots.
- Order: Fabales.
- Family: Fabaceae.
- Subfamily: Mimosoideae.
- Genus: *Pithecellobium*.
- Species: *Pithecellobium dulce* (Vaidya and Vishwakarma, 2020).

Ethnomedicinal Uses

In traditional medicine in Asia and Africa, the plant has been used to treat dermatological diseases, gastrointestinal ailments, and inflammatory conditions (Mule *et al*., 2005). The leaves are employed as diuretics and antidiabetics, controlling hyperglycaemia and urinary problems (Tejashwini *et al*., 2015). The bark's high tannin content complies with tradition to treat chronic dysentery, bleeding gums, ulcers and mouth sores through an astringent and haemostatic decoction (Kulkarni and Jamakhandi, 2018). The seeds are used to treat skin disorders like leprosy, sores that won't heal as well as mouth diseases including toothaches and swelling of the gums (Singh *et al*., 2023). Its fruit peel's high phenolic and flavonoid content means it is helpful in the treatment of inflammation-based illnesses, digestive disorders generally, and loss of strength overall (Selvakumar *et al*., 2023).

Bioactive Potential

Its bark, seeds, and leaves are rich in tannins, flavonoids, saponins, steroids, and other bioactive compounds, making it medicinally significant (Zapesochnaya *et al*., 1980). Sterols, coumarins, and flavonoids were among the 67 bioactive components found in its leaves by UPLC-ESI-MS/MS analysis, creating a thorough chemical fingerprint for the species (Elhewehy *et al*., 2025). A 2013 study confirmed the antibacterial qualities of *Pithecellobium dulce*, an herb that has long been used in traditional medicine. Measurable antibacterial activity against *Escherichia coli* and *Staphylococcus aureus* was demonstrated using ethanolic leaf extracts, supporting ethnomedical claims of wound-healing and anti-infective qualities (Kumar *et al*., 2013). Wood bark and leaf extracts exhibited high levels of total phenolics and flavonoids, which were strongly associated with their *in vitro* radical-scavenging activities (DPPH, hydroxyl, and nitric oxide assays) and metal-chelating ability, highlighting these tissues as valuable sources of antioxidants (Katekhaye and Kale, 2012). Through DPPH and superoxide radical scavenging, seed extracts showed notable antioxidant capacity, supporting their traditional use in the treatment of illnesses linked to oxidative stress (Nagmoti *et al*., 2012). It can control blood glucose levels comes from antidiabetic studies (Sugumaran and Vetrichelvan, 2008).

Ethno-linguistic nomenclature of *Pithecellobium dulce*

The vernacular names of *P. dulce* are listed in Table 1.

Synonyms of *Pithecellobium dulce*

The approved species name and synonyms of *Pithecellobium dulce* are presented in Table 2 (Bharathi *et al*., 2023; Kotb *et al*., 2024; Ocampo-Lopez *et al*., 2023; Thamo *et al*., 2023).

ISOLATION AND CHARACTERIZATION OF PHYTOCONSTITUENTS

The important phytoconstituents that have been isolated from various plant parts of *Pithecellobium dulce* and their bioactive fractions are described below.

Seed and coat

GC-MS analysis enabled the identification of the phytochemicals present in the seed extract of *Pithecellobium dulce*, which included a large number of compounds that had molecular weights ranging from 90-353 g/mol and a potentially active compound (Shafeen *et al*., 2025). The methanolic extract (2 mL, 1:10 w/v) of seed and seed coat was then mixed with 2.8 mL distilled water, 0.1 mL 10% aluminium chloride solution, and 0.1 mL 1M potassium acetate solutions, and the absorbance at 425nm was read using a spectrophotometer after a 30-min interval at room temperature. The amount of flavonoids was measured using a rutin calibration curve, and the results were reported as mg rutin equivalents per g of dry extract (Shafeen *et al*., 2025). The seed extract contains D-turanose (55.8%), inositol derivatives (6.5%), hexadecanoic acid (12%), dihydroxyacetone (1.6%), D-gluco-hexodialdose (0.8%), 2-deoxy-galactopyranose (0.2%), ribitol (0.2%), D-mannose (0.2%), and altronic acid (0.65%). The seeds contain high sugar composition, especially

D-Turanose (3-O-α-D-glucopyranosyl-D-fructose). These sugars have numerous biological properties, such as antioxidant, antibacterial, and anticancer properties (El-Shahir *et al.*, 2022). High concentration of both saturated and unsaturated fatty acids was found to be present in the extract which is attributed to its antibacterial properties (Khanzada *et al.*, 2013). The fatty acids can be utilized to kill bacterial cells by disrupting their membranes or inhibiting their formation (Bazaid *et al.*, 2018; McGaw *et al.*, 2002).

Aril

High-Performance Liquid Chromatography (HPLC) analysis evidenced from the extract of ripe fruit of *Pithecellobium dulce* that gallic acid, vanillic acid, caffeic acid, catechin, and rutin were the predominant phenolic components. Phenolics derived from aril directly inhibited the two enzymes - collagenase and hyaluronidase - which are important in the aging process of the skin (Chiangnoon *et al.*, 2023). Dried aril contains very high insoluble hemicellulose and soluble pectin. The prebiotic potential of the aril is highlighted by the fact that these fibres are transformed *in vivo* into Short-Chain Fatty Acids (SCFAs), mainly propionic and butyric acids (Lopez-Angulo *et al.*, 2025). The effect of drying technique on the phenolic profile was determined by HPLC-DAD analysis of *Pithecellobium dulce* arils. The most important components were found to be ferulic, hydroxyphenyl acetic, p-coumaric, and chlorogenic acids. These heat-sensitive phenolics base showed better retention by freeze-drying than by oven drying and were maintained for their apoptosis-inducing capacity in SW480 colon cancer cells (Hernández-Bolio *et al.*, 2025). The fermentation aril produces bioavailable fermentation products, including simple phenolic acids and dihydro-resveratrol from complex polyphenols; additionally, short-chain fatty acids and bioactive peptides are increased as an added boost to the nutritional and functional capability of an aril (Sivamaruthi *et al.*, 2023).

The chemical constituents present in the seed, coat and aril of *Pithecellobium dulce* are given in Figure 1.

Bark

Pithecellobium dulce bark reported 63.45% of cellulose, 14.56% of hemicellulose and 8.45% of lignin contents based on a 2013 study. The high cellulose-to-lignin ratio imparts significant tensile strength and thermal stability (up to 339°C), which confirmed their suitability for green composite reinforcement (Khandare *et al.*, 2024). A 2025 study of bark and leaves found quercetin-rich leaves and bark with phenolic acids and glycosides such as olein. Bark metabolites possess strong anti-venomous and anti-inflammatory properties absent in the aril (Al-Obaidi and Al-Mohammedi, n.d.). By reducing the lignin content from 27.5% to 21.9% through photooxidative alteration of its lignocellulosic matrix, optical transparency was improved while structural integrity was preserved. These results demonstrate the viability of creating translucent bio composites from woody biomass for environmentally friendly uses in building and optics (Piedra-Ambriz *et al.*, 2025). Bark has a high biosorptive efficiency for removing hexavalent chromium, and FTIR confirms that it contains a lot of -OH and -NH_2 groups. The biomass works best as a cation exchanger at pH 5, which supports its application in sustainable wastewater valorisation (Rosca *et al.*, 2023). The chemical constituents present in the bark and gum of *Pithecellobium dulce* are given in Figure 2.

Leaf

Pithecellobium dulce leaf extract has a function as a green reductant in the combustion-based production of CuO nanoparticles. The leaf's usefulness in green catalysis outside of biomedical applications was highlighted by FTIR confirmation of O-H and C=C functional groups, with polyphenolic chemicals serving as catalysts in the Ullmann coupling for diphenyl ether (Kalaivani and Mathubala, 2025). The leaf extract showed 66.7% pediculicidal efficacy, outperforming bark/fruit, via metabolite-driven disruption (Gudulkar *et al.*, 2025). The activated charcoal

Table 1: Vernacular names of *Pithecellobium dulce*.

Sl. No.	Language	Vernacular names	References
1.	English	Manila tamarind, Madras thorn, Black bead tree, Jungle jalebi, Monkey pod	(Dzinyela *et al.*, 2023; Ramírez-Albores *et al.*, 2024; Rachana Sree *et al.*, 2024)
2.	Hindi	Vilayati babul, Vilayati imli, Jungle jalebi	(Al-Obaidi and Al-Mohammedi, 2025; Rachana Sree *et al.*, 2024)
3.	Tamil	Kodukkapuli	(Al-Obaidi and Al-Mohammedi, 2025; Rachana Sree *et al.*, 2024)
4.	Telugu	Seema chinta, Cheema chinta	(Al-Obaidi and Al-Mohammedi, 2025; Rachana Sree *et al.*, 2024)
5.	Spanish	Guamuchil, Manila tamarind	(Ramírez-Albores *et al.*, 2024)
6.	Philippines	Kamunsil	(Cordero and Lander, 2025)
7.	Thai	Bak Kham Pae	(Sonthongphithak *et al.*, 2024)

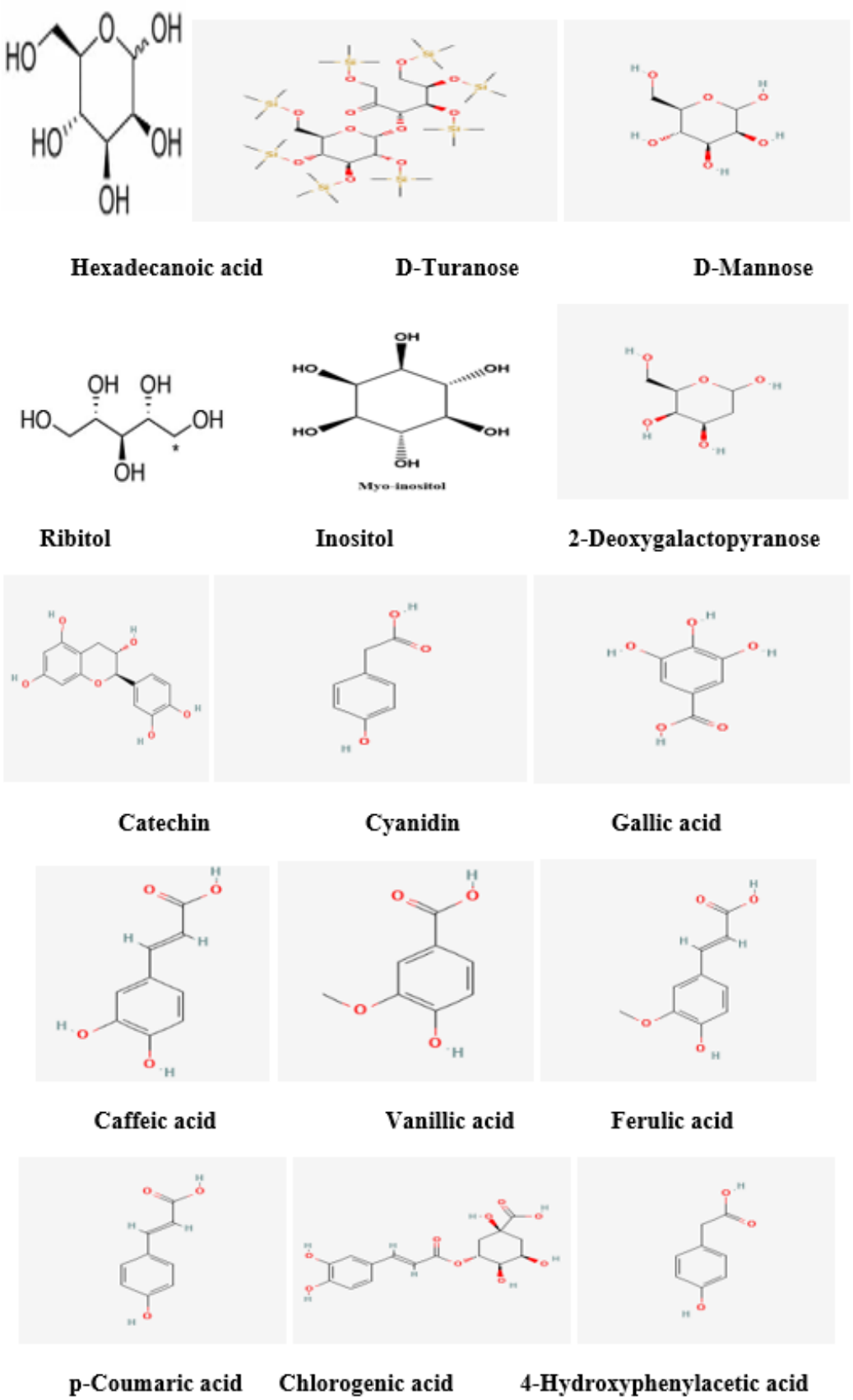

Figure 1: Chemical constituents in the seed, coat and aril of *Pithecellobium dulce*.

Table 2: Synonyms of *Pithecellobium dulce*.

Synonyms of *Pithecellobium dulce*
Mimosa dulcis Roxb.
Acacia obliquifolia M. Martens and Galeotti
Albizia dulcis (Roxb0 F. Muell
Feuilleea dulcis (Roxb.) Kuntze
Inga dulcis (Roxb.) Willd.
Inga javana DC.
Inga javanica DC
Inga leucantha C. Presl
Inga pungens Willd.
Mimosa edulis Gagnep
Mimosa pungens (Willd.) Poir
Mimosa unguis-cati Blanco
Pithecellobium littorale Record
Zygia dulcis (Roxb) Lyons
Pithecollobium dulce (Roxb.) Benth

prepared from the leaves of *Pithecellobium dulce* exhibited a high surface area, with acidic groups such as lactones, phenols, thus allowing electrostatic adsorption and the ensuing effective elimination of cationic dyes like Methylene Blue from wastewater (Bhuvaneswari *et al*., 2023). The leaves of *Pithecellobium dulce* acted on CuO nanoparticles by reducing them with amines and carbonyls; further, the extract of the leaf acted through acidic groups with Methylene Blue when converted into activated carbon for bacterial action against *S. aureus* (Vasanharaja *et al*., 2023). Ag ions were rapidly reduced to AgNPs, for which the tannins and flavonoids acted as the key bio-reductants. The study highlights the environment-friendly prospects of this approach as a natural alternative to chemical synthesis techniques (Prabhavathi *et al*., 2023). The leaf extract acted as a stabilizer in the synthesis of the ZnO nanoparticles. Further, its phytochemicals bio-capped the particles to control their size in the range of 20-30 nm, which was important for retaining stability and biological compatibility of the nanoparticles (Senthilkumar *et al*., 2023). The chemical constituents present in the leaf of *Pithecellobium dulce* are given in Figure 3.

Root

The root extract of *Pithecellobium dulce* has strong bactericidal properties in relation to *Staphylococcus aureus, Klebsiella pneumoniae*, and *E. coli*, which are similar to those of conventional antibiotics as a result of the presence of flavonoids and polyphenols that disrupt the bacterial cell wall for penetration by breaking it down. The remarkable pharmacological property of the plant makes its traditional usage for the treatment of inflammation and gastrointestinal diseases valid (Bhat *et al*., 2018). Compared analyses demonstrate the root's characteristic fatty acids and trace elements that are quite distinct from the characteristic high lipids of the seeds, with approximately 10.6% crude protein content, an impressive quantity among root structures but lower than seeds, and supplemented by valuable minerals like potassium and zinc for better health potential (Khanzada *et al*., 2013). In toxin-induced liver injury, ethanolic extracts of *Pithecellobium dulce* root show significant hepatoprotective activity. Phytochemical screening revealed triterpenoids, glycosides, and catechol-type tannins that lower serum enzymes such as Serum Glutamate Oxaloacetate Transaminase, Serum Glutamate Pyruvate Transaminase reflecting strong antioxidant activity and membrane-stabilizing potential (Thirumalai *et al*., 2012).

Flowers

Pithecellobium dulce flowers are rich in flavonoid glycosides, particularly quercetin, rutin, and kaempferol and phenolic compounds such as steroids and triterpenoidal saponins, which support their traditional use in mild inflammation (Sahu and Saxena, 2013; Bamniya and Verma, 2012; Mishra *et al*., 2011). Antioxidant tests shows that the flowers have the ability scavenge free radicals which is stronger than that of the root but weaker than that of the seed coat (Sahu and Saxena, 2013; Bamniya and Verma, 2012; Mishra *et al*., 2011). Compared to other Fabaceae plants, *Pithecellobium dulce* flowers produce nectar that is hexose-dominant yet rich in sucrose, with key amino acids like proline and glutamic acid that nourish pollinators, and the resulting honey carries a distinct pH 3.9, about 18% moisture, and strong antioxidant activity and minerals such as calcium and potassium (Raju and Rao, 2006; Moniruzzaman *et al*., 2013). The chemical constituents present in the flowers of *Pithecellobium dulce* are given in Figure 4.

Gum (Exudate)

Arabinose and galactose make up the majority of the arabinogalactan-rich heteropolysaccharide found in the trunk gum of *Pithecellobium dulce*, with minor levels of glucose and rhamnose. Strong hydrogen bonding potential is highlighted by FTIR analysis, which also validates its safety for usage in food and medicine due to the absence of hazardous proteins. This natural gum stands out as a dependable, plant-based substitute for conventional gums due to its shear-thinning flow behaviour and heat durability up to 220°C, particularly when encasing sensitive substances like rosemary oil (Chaudhari and Annapure, 2020; Sharma and Mehta, 2013). The trunk contains cellulose-rich fibres with low lignin, giving them high tensile strength and durability. Its heartwood is enriched with natural tannins and flavonoids, offers more resistance to fungal decay, making it well-suited for light construction and other long-lasting applications (Manimaran *et al*., 2020; Rutiaga *et al*., 1998; Magdum *et al*., 2011).

PHARMACOLOGICAL ACTIVITY OF *PITHECELLOBIUM DULCE*

Pithecellobium dulce has a good therapeutic value in traditional medicine for treating ulcers, earaches, toothaches, intestinal disorders and leprosy. Pharmacological studies confirm its efficacy, possessing antioxidant, anti-inflammatory and hepatoprotective effects due to the presence of flavonoids, saponins and tannins. The plant also neutralizes animal toxins, including snake venom, and functions as an ecofriendly agent against disease (Megala and Geetha, 2010; Pithayanukul *et al.*, 2005).

Adulticidal activity

Pithecellobium dulce crude leaf and seed extracts were examined in a variety of solvents, and the results indicated that methanol leaf extract was more effective than seed extract (LC_{50}=309.24 ppm; LC_{90}=570.80 ppm) at 234.97 ppm and 464.86 ppm, respectively. Strong adulticidal potential against the filariasis vector was confirmed by the fact that no controls died (Govindarajan *et al.*, 2012). Green-synthesized titanium dioxide (TiO_2) nanoparticles from *Pithecellobium dulce* leaves exhibit strong adulticidal activity against *Aedes aegypti* and *Culex quinquefasciatus*. Their toxicity arises from exoskeletal damage and cellular disruption via oxidative stress, underscoring the potential of plant-mediated TiO_2 nanomaterials as eco-friendly alternatives for sustainable vector control (Murugan *et al.*, 2012). It has efficacy against *Anopheles stephensi*, combining strong repellent with adulticidal effects and offers protection for more than 180 min at 5.0 mg/cm² (Rajeswary and Govindarajan, 2016). These crude extracts have exhibited remarkable adulticidal effect against the malaria vector *Anopheles stephensi*, with bioactive components most likely interfering with the neurological and physiological processes of the mosquito (Velayutham *et al.*, 2013). *Pithecellobium dulce* seeds besides controlling mosquitoes produce Kunitz-type protease inhibitors that interfere with adult pest insects' digestive systems. These inhibitors hamper the absorption of nutrients by attacking the intestinal trypsin and chymotrypsin enzymes, which ultimately leads to malnutrition and death (Sampaio *et al.*, 2009).

Anti-diabetic activity

Pithecellobium dulce fruit peel and leaf extracts have a potent inhibitory effect towards α-amylase and α-glucosidase, slowing down carbohydrate digestion and glucose uptake. It can prevent postprandial hyperglycaemia, thereby emphasizing its phytochemical constituents as a novel, safer, and purified

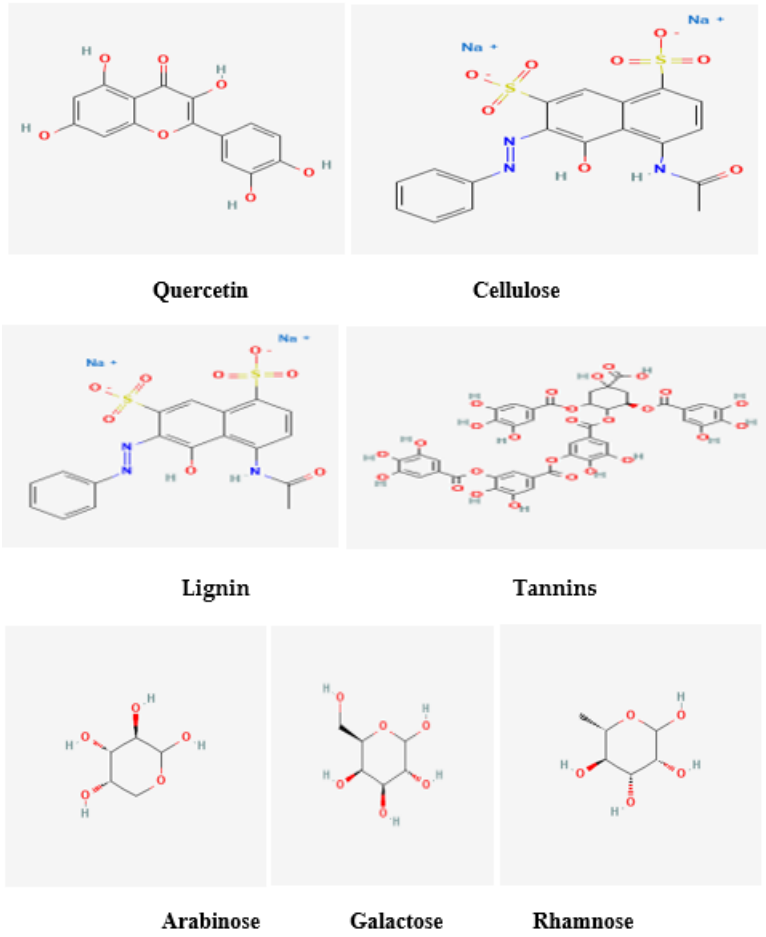

Figure 2: Chemical constituents in bark and gum of *Pithecellobium dulce*.

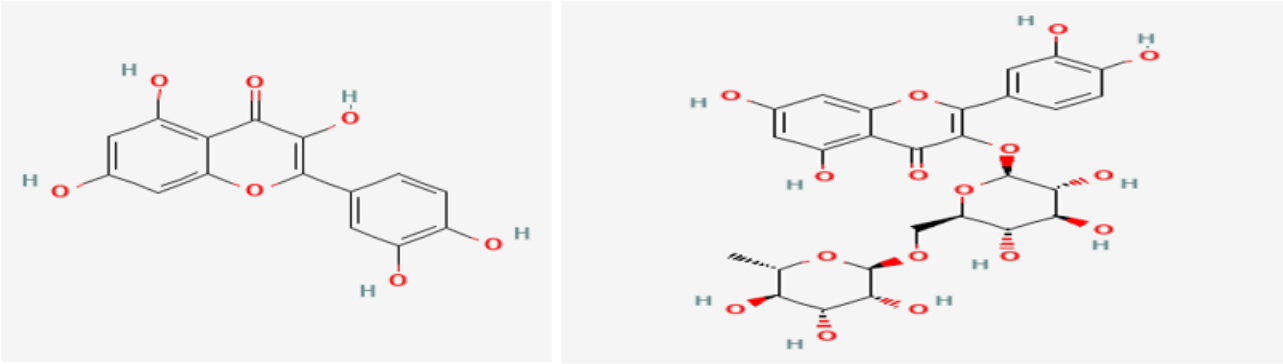

Figure 3: Chemical constituents in leaf of *Pithecellobium dulce*.

antidiabetic agent over their synthetic counterpart (Pradeepa *et al*., 2013; Shankar and Kumar, 2010; Pithayanukul *et al*., 2005). In streptozotocin-induced diabetic models, *Pithecellobium dulce* fruit extracts significantly decreased blood sugar and *HbA1c* levels. Histopathology studies showed a prominent increase in pancreatic β cells, pointing out their potential therapeutic use in curing pancreatic dysregulation and complications from diabetes (Muthumani *et al*., 2010). A saponin-rich fraction from *Pithecellobium dulce* seeds demonstrated a potent anti-hyperglycaemic effect, having therapeutic relevance for diabetes treatment. It shown an amelioration effect in blocking gastrointestinal glucose, followed by an increase in glucose tolerance during oral glucose tolerance tests (Palanichamy *et al*., 2012). Quercetin, along with stigmasterol, from *Pithecellobium dulce* fruit peel, effectively prevents non-enzymatic haemoglobin glycation. By reducing *HbA1c* values, it promotes a stronger impact towards long-term glycaemic indecisiveness, thereby asserting its therapeutic relevance for diabetes treatment (Praylin and Lazarus, 2016; Meera *et al*., 2010; Verma *et al*., 2012). Its extracts can also boost the hepatic antioxidant mechanisms by increasing the activity of enzymes such as Superoxide Dismutase (SOD) and catalase, while at the same time relieving the condition of high LDL and VLDL levels associated with high HDL due to diabetes mellitus (Karthikeyan and Deepa, 2011; Palanichamy *et al*., 2012; Sundararajan and Koduru, 2014).

Hepatoprotective activity

The aqueous extract of *Pithecellobium dulce* fruits protected mice from CCl_4-mediated hepatic damage, preventing necrosis and reducing ALT, AST, and lipid levels (Manna *et al*., 2011). Ethanolic extracts from *Pithecellobium dulce* leaves protected rats from paracetamol-induced hepatotoxicity by reducing serum bilirubin levels, hence reducing toxicity, while also elevating antioxidants like glutathione (Pradeepa *et al*., 2013). In drug-induced hepatotoxicity studies, *Pithecellobium dulce* extracts stimulated antioxidant enzymes in the liver (SOD, CAT, GPx) that decreased lipid peroxidation, reducing oxidative stress in drug-induced hepatotoxicity (Jayakumar *et al*., 2014). Ripe fruit extracts from *Pithecellobium dulce* protected the liver from alcohol-induced damage, maintaining normal levels of enzymes, while also maintaining normal tissue (Raju and Jagadeeshwar, 2014). In addition to lowering liver enzymes, *Pithecellobium dulce* extracts also maintained normal serum lipid profiles, alleviating disturbances in cholesterol and triglyceride levels resulting from chemically-induced hepatotoxicity (Mule *et al*., 2013). The aqueous fruit extracts from *Pithecellobium dulce* also demonstrated strong hepatoprotection similar to that of Silymarin, countering lipid peroxidation, thereby maintaining normal levels of antioxidants in the liver (Roselin and Parameshwari, 2025). *Pithecellobium dulce* extracts also reduce heavy metal-induced hepatotoxicity, like cadmium, by chelating heavy metals, hence reducing their adverse effects on antioxidants within the cells of the liver (Sinha *et al*., 2010; Bhattacharjee and Sil, 2007; Yadav *et al*., 2012).

Anti venom and protease inhibitor activity

Aqueous and methanol extracts of *Pithecellobium dulce* bark and leaves have been found to possess potent antivenom action experimentally. These were successful in neutralizing the toxicity of cobra and viper venoms, thereby lessening lethality and muscle damage (Shanmugavel and Vasanthkumar, 2016; Thwin and Gopalakrishnakone, 2010; Pithayanukul *et al*., 2005). A Kunitz-type trypsin inhibitor, named *Pithecellobium dulce* trypsin inhibitor (PDTI), of high stability has been obtained from *Pithecellobium dulce* seeds. However, this protein resisted inactivation by heating and pH changes, making it a very promising compound in preparing antivenom mixtures (Delgado-Vargas and Paredes-Lopez, 1997; Bhattacharyya and Babu, 2007; Sampaio *et al*., 2014). The protein inhibitors of *Pithecellobium dulce* were found to possess efficacy in inhibiting papain, chymotrypsin, and other proteases. The reason is that *Pithecellobium dulce* protein inhibitors possess multifaceted

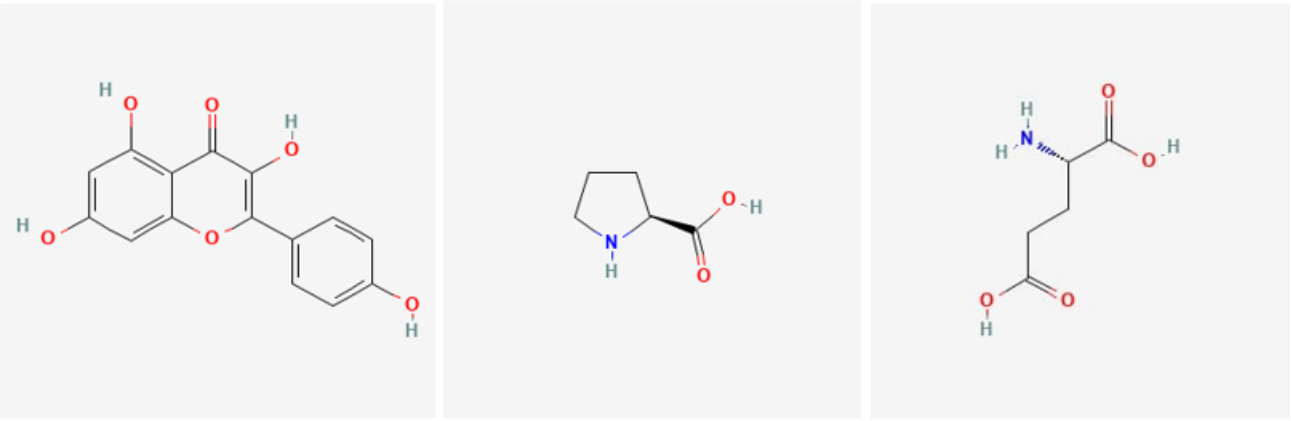

Figure 4: Chemical constituents in flowers of *Pithecellobium dulce*.

effects, advancing their utility in inhibiting various components of venoms, depending on proteolysis (Rawdkuen *et al*., 2012).

Antifungal Activity

Aqueous and powdered extracts from *Pithecellobium dulce* seeds and leaves inhibited the growth of *Rhizopus stolonifer* and *Colletotrichum gloeosporioides*, major post-harvest pathogens of horticultural crops (Barrera-Necha *et al*., 2003). It's methanolic leaf extracts exhibited profound fungicidal effect against *Fusarium oxysporum* and *Pestalotiopsis* sp., which was reflected in inhibition zones comparable to that of common synthetic fungicides (Ali *et al*., 2018). Alcoholic and alkaloidal extracts from the leaves of *Pithecellobium dulce* exhibited strong antifungal effects against *Candida albicans*, a common human pathogen, by disrupting the integrity of fungal cell membrane (Shanmugakumar *et al*., 2006). Citrus fruit extracts of *Pithecellobium dulce* are effective to inhibit *Penicillium digitatum*, which delays sporulation besides reducing storage decay (Bautista-Baños *et al*., 2003). Due to spore disruption, silver nanoparticles prepared from leaf extract of *Pithecellobium dulce* manifested enhanced antifungal efficacy against *Aspergillus niger* and *Aspergillus flavus* (Dutta *et al*., 2020). Triterpene saponins and phenolic chemicals, which impair the permeability of fungal plasma membrane and induce cell death, are the prime contributors for antifungal action of *Pithecellobium dulce* preparations (Murugan and Saranraj, 2011). Coating strawberries with extracts of *Pithecellobium dulce* strikingly reduced fungal deterioration and maintained its quality attributes like firmness and colour during cold storage (Schwieterman *et al*., 2008).

Antihyperlipidemic Activity

The leaves of *Pithecellobium dulce* have shown a remarkable decrease in the levels of cholesterol, triglycerides, and LDL cholesterol in the serum of high-fat diet-induced obese rats, hence making it a potent hypolipidemic agent (Sundarrajan and Rajeswari, 2018). The methanolic fruit extract prevents the action of HMG-CoA reductase, the rate-controlling step of cholesterol synthesis, hence reducing endogenous cholesterol (Sahoo *et al*., 2019). Seed-derived saponins stimulate the secretion of bile acids and sterols, hence reducing systemic lipids (Zhang *et al*., 2022). The studied extract demonstrated its potential in the reduction of lipids in Triton WR-1339-induced hyperlipidemia and was comparable to the existing medication atorvastatin. The potential of the former as an herbal hypolipidemic agent was demonstrated by the latter (Katekhaye and Nagmoti, 2017). When the histopathological analyses of the treated group's liver tissue are considered for comparison with the untreated control group, the result clearly indicates the diminished accumulation of lipids in the former, hence improving the potential of the substance in becoming a better hypolipidemic agent by preventing the development of steatosis in the diet (Preethi *et al*., 2020). This substance significantly raised the levels of HDL-C, hence making it a better agent in the regulation of the lipid profile of the organism (Kumar *et al*., 2018). The peel extract contains Bioactive fibres that inhibit the absorption of lipids in the intestines by binding them, thus lowering their absorption into the bloodstream (Govindappa *et al*., 2017). Through improved insulin sensitivity and normalization of serum lipid levels, the administration of the seed extract successfully alleviates dyslipidemia in STZ-induced diabetic rats (Nagmoti *et al*., 2015).

CONCLUSION

Pithecellobium dulce has emerged as a remarkably versatile medicinal plant, thanks to its rich mix of bioactive compounds such as flavonoids, phenolic acids, tannins, and saponins. Research so far highlights its wide-ranging therapeutic potential from strong antioxidant, antidiabetic, and liver-protective effects to unique abilities like neutralizing venom, fighting fungal infections, and even serving as an eco-friendly tool for vector control. Pre-clinical trials have helped to elucidate its mechanism

of action, its capacity to inhibit major enzymes involved in its action such as α-*amylase*, and its capacity to modulate reactive oxygen stress pathways. Although these positive leads are available, their translation into a real-world setting is still not feasible. The major hurdles that still exist are the lack of standardized extraction methods and a comprehensive toxicity profile. Going forward, it is important that research work identify major active constituents of the herb and elucidate its exact molecular targets, and design proper clinical trials so that *P. dulce* can truly be tapped as a scientific source of innovative phyto and nutraceuticals.

ACKNOWLEDGEMENT

The authors would like to thank the Department of Pharmaceutical Chemistry, SNS College of Pharmacy and Health Sciences, for providing the necessary facilities to carry out this review.

ABBREVIATIONS

QE: Quercetin equivalents; **GAE:** Gallic acid equivalents; **DPPH:** 2,2-diphenyl-1-picrylhydrazyl (radical-scavenging assay); **IC_{50}:** Concentration required to achieve 50% inhibition; **UPLC-ESI-MS/MS:** Ultra-Performance Liquid Chromatography-Electrospray Ionization-Tandem Mass Spectrometry; **GC-MS:** Gas Chromatography-Mass Spectrometry; **HPLC:** High-Performance Liquid Chromatography; **SCFAs:** Short-Chain Fatty Acids; **HPLC-DAD:** High-Performance Liquid Chromatography with Diode-Array Detection; **FTIR:** Fourier-Transform Infrared Spectroscopy; **AgNPs:** Silver nanoparticles; **ZnO:** Zinc oxide; **CuO:** Copper oxide; **LC_{50}:** Lethal concentration for 50% of the population; **LC_{90}:** Lethal concentration for 90% of the population; **TiO_2:** Titanium dioxide; **HbA1c:** Glycated hemoglobin; **SOD:** Superoxide dismutase; **LDL:** Low-Density Lipoprotein; **VLDL:** Very-Low-Density Lipoprotein; **HDL:** High-Density Lipoprotein; **CCl_4:** Carbon tetrachloride; **ALT:** Alanine aminotransferase; **AST:** Aspartate aminotransferase; **CAT:** Catalase; **GPx:** Glutathione peroxidase; **PDTI:** *Pithecellobium dulce* trypsin inhibitor; **HMG-CoA:** 3-Hydroxy-3-methylglutaryl-coenzyme A; **STZ:** Streptozotocin.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

SUMMARY

Pithecellobium dulce, commonly known as Jungle Jalebi or Kodukkapuli, is a medicinal tree native to Tropical America and widely cultivated in India. Its various parts (leaves, bark, seeds, aril, fruits) are rich in bioactive phytoconstituents including flavonoids, tannins, saponins, and phenolic acids. The plant exhibits significant pharmacological activities including antioxidant, anti-inflammatory, antidiabetic, hepatoprotective, and antimicrobial effects. Notably, it possesses anti-venom properties and eco-friendly larvicidal capabilities. While current research validates its traditional uses, future studies must focus on standardized extraction, toxicity profiling, and clinical trials to develop therapeutic applications.

REFERENCES

Ali, M., Diso, S. U., and Ali, S. (2018). Phytochemical screening and antifungal activity of *Pithecellobium dulce*. *Journal of Pharmacognosy and Phytochemistry*, *7*(1), 2415-2419.

Al-Obaidi, J. F., and Al-Mohammedi, A. F. (n.d.). Nutritional and medicinal properties of *Pithecellobium dulce*: A review article. *Iraqi Journal of Desert Studies*, *15*(1), 1-12.

Al-Obaidi, J. F., and Al-Mohammedi, A. F. Nutritional and medicinal properties of *Pithecellobium dulce*: A review article. *Iraqi Journal of Desert Studies*, (2025). *15*(1), 1-12.

Bamniya, B. R., and Verma, P. (2012). Phytochemical and antimicrobial analysis of *Pithecellobium dulce* plant parts. *Asian Pacific Journal of Tropical Disease*, *2*(Suppl. 1), S239-S243.

Barrera-Necha, L. L., Bautista-Baños, S., *et al.* (2003). Antifungal activity against postharvest fungi by extracts and compounds of *Pithecellobium dulce* seeds. *Acta Horticulturae*, *628*, 761-766.

Bautista-Baños, S., Hernández-Lauzardo, A. N., *et al.* (2003). Plant extracts for the control of postharvest fungi in horticulture: A review. *Postharvest Biology and Technology*, *28*(3), 361-368.

Bazaid, A. S., Forbes, S., Humphreys, G. J., Ledder, R. G., O'Cualain, R., and McBain, A. J. Fatty acid supplementation reverses the small colony variant phenotype in triclosan-adapted *Staphylococcus aureus*: Genetic, proteomic and phenotypic analyses. *Scientific Reports*, *8*(1), 3876.

Bharathi, D., Ranjithkumar, R., Chandarshekar, B., and Bhuvaneshwari, V. Green synthesis of silver nanoparticles using *Pithecellobium dulce* leaf extract and characterizing their potential applications. *Inorganic Chemistry Communications*, (2023). *150*, 110508.

Bhat, M. A., Malik, R. A., Prakash, P., and Lone, A. M. (2018). Preparation and evaluation of antibacterial potential of *Pithecellobium dulce* root extract against Gram-positive and Gram-negative bacteria. *Microbial Pathogenesis*, *116*, 49-53.

Bhattacharjee, N., and Sil, P. C. (2007). The dietary antioxidant quercetin ameliorates carbon tetrachloride-induced hepatic oxidative stress and apoptosis in mice. *Food and Chemical Toxicology*, *45*(5), 817-826.

Bhattacharyya, A., and Babu, C. R. (2007). A rapid and sensitive method for the isolation and purification of a Kunitz-type proteinase inhibitor. *Journal of Chromatography B*, *859*(1), 122-126.

Bhuvaneswari, R., *et al.* (2023). Removal of methylene blue dye from aqueous solution using *Pithecellobium dulce* leaves activated carbon. *Indian Journal of Chemical Technology*, *30*(1), 55-62.

Chaudhari, B. B., and Annapure, U. S. (2020). Physiochemical and rheological characterization of *Pithecellobium dulce* (Roxb.) Benth gum exudate as a potential wall material for the encapsulation of rosemary oil. *Carbohydrate Polymer Technologies and Applications*, *1*, 100005.

Chiangnoon, R., Samee, W., and Jeenapongsa, R. (2023). Effect of *Pithecellobium dulce* (Roxb.) Benth. fruit extract on skin aging enzymes and oxidative stress in keratinocytes. *Plants*, *12*(3), 666.

Cordero, C. S., and Lander, R. R. Ethnobotanical study of medicinal plants used in an urban community in Iloilo City, Philippines. *Biodiversitas Journal of Biological Diversity*, (2025). *26*(5), 2167-2181.

Delgado-Vargas, F., and Paredes-Lopez, O. (1997). Natural pigments: Carotenoids and anthocyanins as potential food colorants and antioxidants. *Journal of Agricultural and Food Chemistry*, *45*(4), 1092-1096.

Dhanisha, S. S., Drishya, S., and Guruvayoorappan, C. Traditional knowledge to clinical trials: A review on nutritional and therapeutic potential of *Pithecellobium dulce*. *Journal of Basic and Clinical Physiology and Pharmacology*, (2022). *33*(2), 133-142.

Dutta, D., Jana, K., and Maity, C. (2020). Green synthesis of silver nanoparticles using *Pithecellobium dulce* and its antifungal application. *SN Applied Sciences*, *2*(6), 1069.

Dzinyela, R., Alhassan, A. R., Movahedi, A., and Sunglo, P. *In vivo* evaluation of *Pithecellobium dulce* leaves anti-bacterial and antihyperlipidaemic activities. *South African Journal of Botany*, (2023). *157*, 1-10.

Elhewehy, A. A., *et al.* Phytochemical profile, UPLC-ESI-MS/MS analysis and anti-Alzheimer's activity of *Pithecellobium dulce* leaves. *Future Journal of Pharmaceutical Sciences*, (2025). *11*(30), 1-19.

El-Shahir, A. A., El-Wakil, D. A., Abdel Latef, A. A. H., and Youssef, N. H. Bioactive compounds and antifungal activity of leaves and fruits methanolic extracts of *Ziziphus spina-christi* L. *Plants*, (2022). *11*(6), 746.

Govindappa, M., Prathap, S., and Vinay, V. (2017). Phytochemical analysis and hypolipidemic activity of *Pithecellobium dulce* peel extract. *Asian Journal of Pharmaceutical and Clinical Research*, *10*(5), 198-202.

Govindarajan, M., Sivakumar, R., Rajeswary, M., and Yogalakshmi, K. (2012). Chemical composition and larvicidal activity of *Pithecellobium dulce* Benth. against *Culex quinquefasciatus*, *Anopheles stephensi*, and *Aedes aegypti*. *Asian Pacific Journal of Tropical Disease*, *2*(2), 124-128.

Gudulkar, S., Kumaran, N. S., and Pimprao, P. (2025). Effect of aqueous extracts of *Pithecellobium dulce* (Roxb.) Benth. against *Pediculus humanus capitis* De Geer, 1778. *ENTOMON*, *50*(3), 311-316.

Hernández-Bolio, G. I., Vargas-Madriz, A. F., Kuri-Garcia, A., *et al.* (2025). Effect of drying methods on the phenolic profile and antioxidant capacity of *Pithecellobium dulce* (Roxb.) Benth aril and its inhibitory properties on human SW480 colon adenocarcinoma cells. *Molecules*, *30*(2), 233.

Jayakumar, S., Madankumar, A., and Asok Kumar, S. (2014). Antioxidant and hepatoprotective potential of *Pithecellobium dulce* against drug-induced toxicity. *Journal of Acute Medicine*, *4*(3), 120-126.

Kalaivani, P., and Mathubala, G. (2025). The green combustion technique for synthesizing CuO nanoparticles with an extract from *Pithecellobium dulce* leaf: Potential catalytic activity. *Asian Journal of Green Chemistry*, *9*(1), 151-166.

Karthikeyan, R., and Deepa, K. (2011). Pharmacological evaluation of *Pithecellobium dulce* extracts. *Hygeia Journal of Dental Medicine*, *3*(2), 34-38.

Katekhaye, S. D., and Kale, M. S. Antioxidant and free radical scavenging activity of *Pithecellobium dulce* (Roxb.) Benth wood bark and leaves. *Free Radicals and Antioxidants*, (2012). *2*(3), 47-57.

Katekhaye, S. D., and Nagmoti, D. M. (2017). Antihyperlipidemic effect of *Pithecellobium dulce* extract in Triton WR-1339 induced hyperlipidemia in rats. *Pharmacology Online*, *1*, 123-130.

Khandare, S. S., Jadhav, R. B., Pimpre, K. A., *et al.* (2024). Pharmacological investigation of *Pithecellobium dulce* stem bark extract for antidepressant activity in mice and rats. *Research Journal of Pharmacy and Technology*, *17*(2), 703-706.

Khanzada, S. K., Khanzada, A. K., Shaikh, W., and Ali, S. A. (2013). Phytochemical studies on *Pithecellobium dulce* Benth., a medicinal plant of Sindh. *Pakistan Journal of Botany*, *45*(2), 557-561.

Khanzada, S. K., Khanzada, A. K., Shaikh, W., and Ali, S. A. Phytochemical studies on *Pithecellobium dulce* Benth., a medicinal plant of Sindh, Pakistan. *Pakistan Journal of Botany*, (2013). *45*(2), 557-561.

Kotb, S. S., Ayoub, I. M., El-Moghazy, S. A., and Singab, A. N. B. Phytochemical analysis of *Pithecellobium dulce* (Roxb.) Benth bark via UPLC-ESI-MS/MS and evaluation of its biological activity. *Natural Product Research*, (2024). *38*(8), 1424-1429.

Kulkarni, K. V., and Jamakhandi, V. R. Medicinal uses of *Pithecellobium dulce* and its health benefits. *Journal of Pharmacognosy and Phytochemistry*, (2018). *7*(2), 700-704.

Kumar, M., Nehara, K., and Duhan, J. S. Phytochemical analysis and antimicrobial efficacy of leaf extract of *Pithecellobium dulce*. *Asian Journal of Pharmaceutical and Clinical Research*, (2013). *6*(1), 70-76.

Kumar, V., Ahmed, D., and Verma, A. (2018). Ameliorative effect of *Pithecellobium dulce* on dyslipidemia and oxidative stress in diabetic rats. *Archives of Physiology and Biochemistry*, *124*(3), 213-220.

Lopez-Angulo, G., Escoto-Herrera, J. A., *et al.* (2025). *Pithecellobium dulce* (Roxb.) Benth. fruit flour intake enhances short-chain fatty acid production and glucose metabolism in BALB/c mice. *Polish Journal of Food and Nutrition Sciences*, *75*(1), 1-12.

Magdum, C. S., Patil, S. S., and Wadkar, G. H. (2011). Phytochemical screening and hepatoprotective activity of *Pithecellobium dulce* wood. *International Journal of Pharmaceutical Sciences and Research*, *2*(10), 2735-2738.

Manimaran, P., Saravanan, S. P., Sanjay, M. R., Siengchin, S., and Jawaid, M. (2020). Characterization of new cellulosic fiber: *Pithecellobium dulce* bark fiber. *International Journal of Polymer Analysis and Characterization*, *25*(3), 129-137.

Manna, P., Bhattacharyya, S., Devi, K. S., and Sil, P. C. (2011). Phytomedicinal role of *Pithecellobium dulce* against CCl_4-mediated hepatic oxidative impairments and necrotic cell death. *Evidence-Based Complementary and Alternative Medicine*, *2011*, 832805.

McGaw, L., Jager, A., and Van Staden, J. (2002). Antibacterial effects of fatty acids and related compounds from plants. *South African Journal of Botany*, *68*(4), 417-423.

Meera, R., Devi, P., and Muthumani, P. (2010). Evaluation of phytochemical and pharmacological properties of *Pithecellobium dulce*. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, *1*(4), 380-385.

Megala, J., and Geetha, A. (2010). Acute and sub-acute toxicity study of hydroalcoholic extract of *Pithecellobium dulce* Benth. in rats. *Food and Chemical Toxicology*, *48*(10), 2633-2638.

Mishra, S. S., Moharana, S. K., and Dash, M. R. (2011). Review on *Pithecellobium dulce*: A pharmacological and phytochemical approach. *International Journal of Research in Pharmaceutical Sciences*, *2*(1), 1-5.

Moniruzzaman, M., *et al.* (2013). Physicochemical and antioxidant properties of Malaysian honeys produced by *Apis cerana*, *Apis dorsata* and *Apis mellifera*. *BMC Complementary and Alternative Medicine*, *13*, 43.

Mule, V. S., Jadhav, S. D., and Patil, W. S. (2013). Hepatoprotective activity of *Pithecellobium dulce* leaves in CCl_4-induced hepatotoxicity. *Pharmacology Online*, *2*, 45-50.

Mule, V. S., Patil, S. B., Naikwade, N. S., and Magdum, C. S. Evaluation of antidiarrhoeal and anti-inflammatory activities of *Pithecellobium dulce* in rats. *Phytotherapy Research*, (2005). *19*(12), 1017-1020.

Murugan, K., Hwang, J. S., Kovendan, K., *et al.* (2012). Use of plant-synthesized silver nanoparticles for the control of *Anopheles stephensi* and *Aedes aegypti*. *Parasitology Research*, *111*(3), 1229-1237.

Murugan, T., and Saranraj, P. (2011). Antibacterial and antifungal activity of *Pithecellobium dulce*. *International Journal of Microbiological Research*, *2*(3), 213-216.

Murugesan, S., Lakshmanan, D. K., Arumugam, V., and Alexander, R. A. Nutritional and therapeutic benefits of medicinal plant *Pithecellobium dulce* (Fabaceae): A review. *Journal of Applied Pharmaceutical Science*, (2019). *9*(7), 130-139.

Muthumani, P., Meera, R., Devi, P., *et al.* (2010). Antidiabetic activity of *Pithecellobium dulce* fruits in streptozotocin-induced diabetic rats. *International Journal of PharmTech Research*, *2*(3), 1914-1920.

Nagmoti, D. M., Khatri, D. K., Juvekar, P. R., and Juvekar, A. R. Antioxidant activity and free radical-scavenging potential of *Pithecellobium dulce* seed extracts. *Free Radicals and Antioxidants*, (2012). *2*(2), 37-43.

Nagmoti, D. M., Kulkarni, A. R., and Juvekar, P. R. (2015). Antidiabetic and antihyperlipidemic activity of *Pithecellobium dulce* seeds extract in streptozotocin-induced diabetic rats. *European Journal of Integrative Medicine*, *7*(3), 263-273.

Ocampo-Lopez, J., Soto-Simental, S., Aguilar-Raymundo, V. G., and Ayala-Martinez, M. Dietary supplementation with *Pithecellobium dulce* (Roxb.) Benth fruits to fattening rabbits. *Animals*, (2023). *13*(20), 3249.

Palanichamy, P., Selvakumar, M., and Aathmanathan, S. (2012). Antihyperglycemic potential of saponin enriched fraction from *Pithecellobium dulce* Benth. seed extract. *Global Journal of Pharmacology*, *6*(3), 236-241.

Palanichamy, P., Selvakumar, M., and Aathmanathan, S. (2012). Antihyperglycemic potential of saponin-enriched fraction from *Pithecellobium dulce* Benth. seed extract. *Global Journal of Pharmacology*, *6*(3), 236-241.

Piedra-Ambriz, B. K., Vasquez-Garcia, S. R., Flores-Ramirez, N., Ortiz-Gutiérrez, M., García-González, L., Domratcheva-Lvova, L., and Perez-Bueno, J. (2025). Guamuchil wood (*Pithecellobium dulce*) subjected to oxidation processes to increase transparency. *European Journal of Wood and Wood Products*, *83*(4), 136.

Pithayanukul, P., *et al.* (2005). Antioxidant and antimicrobial activities of plant-derived compounds. *Journal of Ethnopharmacology*, *97*(3), 527-533.

Pithayanukul, P., *et al.* (2005). *In vitro* CNS activity of *Pithecellobium dulce* Benth. extract. *Journal of Ethnopharmacology*, *97*(3), 527-533.

Pithayanukul, P., Ruenraroengsak, P., Bavovada, R., Pakmanee, N., Suttisri, R., and Saenoon, S. (2005). *In vitro* CNS activity of *Pithecellobium dulce* Benth. extract. *Journal of Ethnopharmacology*, *97*(3), 527-533.

Prabhavathi, P., *et al.* (2023). Green synthesis of silver nanoparticles using *Pithecellobium dulce* leaf extract and its antibacterial activity. *Materials Today: Proceedings*, *80*(2), 1600-1604.

Pradeepa, M., Kalavathy, S., and SenthilKumar, K. (2013). Hepatoprotective activity of *Pithecellobium dulce* leaves against paracetamol-induced hepatic damage. *International Journal of Pharmaceutical Science Research*, *4*(11), 4292-4298.

Pradeepa, M., Kalavathy, S., Kumar, H. K., *et al.* (2013). Evaluation of phytochemical constituents and biological activities of *Pithecellobium dulce*. *International Journal of Pharmaceutical Sciences*, *5*(4), 436-439.

Praylin, S., and Lazarus, Y. (2016). Antidiabetic activity of *Pithecellobium dulce* extracts in experimental models. *Journal of Diabetes Mellitus*, *6*(3), 215-224.

Preethi, R., Devanathan, V., and Loganathan, M. (2020). Bioactive compounds from *Pithecellobium dulce* and their role in lipid metabolism regulation. *Biomedicine and Pharmacotherapy*, *126*, 110065.

Rachana Sree, S., Supraja, T., Aparna, K., Prasuna, M., and Srinivasa Chary, D. Standardization and sensory evaluation of Manali tamarind (*Pithecellobium dulce*)-based chutney powder. *AATCC Review*, (2024). *12*(1), 225-231.

Rajeswary, M., and Govindarajan, M. (2016). Mosquito repellent potential of *Pithecellobium dulce* leaf and seed against malaria vector, *Anopheles stephensi*. *Journal of Coastal Life Medicine*, *4*(3), 236-239.

Raju, A. J. S., and Rao, S. P. (2006). Nesting habits, floral resources and foraging ecology of large carpenter bees (*Xylocopa latipes*). *Current Science*, *90*(9), 1210-1217.

Raju, K., and Jagadeeshwar, K. (2014). Phytochemical investigation and hepatoprotective activity of ripe fruits of *Pithecellobium dulce* in albino rats. *Scholars Academic Journal of Pharmacy*, *3*(6), 449-454.

Ramírez-Albores, J. E., Badillo-Yáñez, A., and Ramírez-Cedillo, E. Multiple uses of wild edible trees by a Nahua-origin community in western Mexico. *Plants*, (2024). *13*(23), 3334.

Rawdkuen, S., Sai-Ut, S., and Benjakul, S. (2012). Properties of protease inhibitors from *Pithecellobium dulce* seeds and their application. *Food Chemistry*, *133*(4), 1238-1244.

Rosca, M., Hlihor, R. M., and Cozma, P. (2023). Valorization of natural adsorbents for removing chromium (VI) from industrial wastewater: A review. *Frontiers in Environmental Science*, *11*, 1170347.

Roselin, C., and Parameshwari, S. (2025). Hepatoprotective effect of aqueous extract of *Pithecellobium dulce* fruit pulp against carbon tetrachloride-induced hepatotoxicity. *Asian Journal of Dairy and Food Research*, *44*(4), 568-577.

Rutiaga, J. G., Windeisen, E., and Schumacher, P. (1998). Chemical analysis of the wood of *Pithecellobium dulce*. *Holz als Roh- und Werkstoff*, *56*(6), 400.

Sahoo, S., Das, D., and Tripathy, N. K. (2019). Evaluation of antihyperlipidemic activity of *Pithecellobium dulce* fruit extract. *Journal of Applied Pharmaceutical Science*, *9*(2), 045-051.

Sahu, R. K., and Saxena, J. (2013). Screening of phytochemicals and antimicrobial potential of *Pithecellobium dulce* (flowers). *International Journal of Pharmaceutical Sciences Review and Research*, *21*(2), 208-211.

Sampaio, M. U., *et al.* (2014). Structural and functional characterization of a protease inhibitor from the seeds of *Pithecellobium dulce*. *International Journal of Biological Macromolecules*, *68*, 124-129.

Sampaio, M. U., Oliva, M. L., Tanaka, A. S., and Sampaio, C. A. (2009). Plant proteinase inhibitors: A review of their potential in therapeutic applications. *Protein and Peptide Letters*, *16*(12), 1526-1532.

Schwieterman, M. L., Paull, R. E., and Chen, N. J. (2008). Efficacy of plant extracts on fruit decay. *HortScience*, *43*(4), 1205-1213.

Selvakumar, M., Palanichamy, P., Arumugam, V., Venkatesan, M., Aathmanathan, S., Krishnamoorthy, H., and Pugazhendhi, A. *In silico* potential of nutraceutical plant of *Pithecellobium dulce* against GRP78 target protein for breast cancer. *Applied Nanoscience*, (2023). *13*(3), 1737-1749.

Senthilkumar, N., *et al.* (2023). Green synthesis of ZnO nanoparticles using *Pithecellobium dulce* leaf extract and their characterization. *Materials Today: Proceedings*, *80*(2), 1250-1255.

Shafeen, A., Bradosty, S. W., Shaikh, F. K., and Hallur, R. L. S. [Phytochemical and biological investigation of *Pithecellobium dulce*]. *Journal of Applied and Natural Science*, (2025). *17*(1), 87-95.

Shankar, P., and Kumar, S. (2010). Adulticidal and repellent activity of *Pithecellobium dulce* extracts against mosquito vectors. *Journal of Herbal Medicine and Toxicology*, *4*(2), 81-86.

Shanmugakumar, S. D., Amerjothy, S., and Balakrishna, K. (2006). Pharmacognostical, antibacterial and antifungal potentials of the leaf extracts of *Pithecellobium dulce* Benth. *Pharmacognosy Magazine*, *2*(8), 239-243.

Shanmugavel, G., and Vasanthkumar, M. (2016). Phytochemical screening and GC-MS analysis of *Pithecellobium dulce* Benth leaf extract. *South Indian Journal of Biological Sciences*, *2*(2), 245-249.

Sharma, S., and Mehta, B. K. (2013). A review on pharmacological activities of *Pithecellobium dulce* extract, and their effective doses. *Journal of Medical Pharmaceutical and Allied Sciences*, *2*, 35-45.

Shukla, M., Singh, A., Ghosh, P., Chatterjee, S., and Singh, P. Systematic review on evidence-based therapeutic potential of *Pithecellobium dulce* for health benefits. *Toxicology International*, (2024)*31*(2), 249-56.

Singh, R. K., Kumar, P., and Sharma, S. A comprehensive review on the pharmacological potential of *Pithecellobium dulce*. *Evidence-Based Complementary and Alternative Medicine*, *2023*, 2848198.

Sinha, M., *et al.* (2010). Amelioration of ionizing radiation-induced lipid peroxidation and DNA damage by *Pithecellobium dulce* Benth. extract. *Journal of Biochemical and Molecular Toxicology*, *24*(1), 48-56.

Sivamaruthi, B. S., Kesika, P., and Chaiyasut, C. (2023). A review on the phytochemical and pharmacological profile of fermented *Pithecellobium dulce*. *Fermentation*, *9*(3), 289.

Sonthongphithak, P., Sinsiri, W., Theerakulpisut, P., and Junsongduang, A. Ethnomedicinal properties of wild edible fruit plants and their horticultural potential among indigenous Isan communities in Roi Et Province, northeastern Thailand. *Plants*, (2024). *13*(3), 403.

Srinivas, G., Geeta, H. P., Shashikumar, J. N., and Champawat, S. A review on *Pithecellobium dulce*: A potential medicinal tree. *International Journal of Chemical Studies*, (2018). *6*(2), 540-544.

Sugumaran, M., and Vetrichelvan, T. Anti-diabetic activity of the leaf extract of *Pithecellobium dulce* in alloxan-induced diabetic rats. *Asian Journal of Research in Chemistry*, (2008). *1*(2), 86-89.

Sundararajan, R., and Koduru, R. (2014). Antidiabetic and antioxidant activity of *Pithecellobium dulce*. *International Journal of Phytopharmacology*, *5*(3), 192-197.

Sundarrajan, T., and Rajeswari, M. (2018). Hypolipidemic activity of *Pithecellobium dulce* leaf extract in high-fat diet-induced obesity in rats. *Journal of Ethnopharmacology*, *216*, 211-218.

Tejashwini, P., Manoj, G., Rudresh, E., Havanur, S. K., Afsar Basha, D., and Sangam Yadav. Phytochemical screening and antioxidant activity of *Pithecellobium dulce* leaves. *International Journal of Pharmaceutical Sciences Review and Research*, (2015). *3*(9), 107-113.

Thamo, T. T., Manigandan, R., Ragupathy, S., Saravanan, R., and Vasanthkumar, S. Green synthesis, characterization and antifungal and photocatalytic activity of *Pithecellobium dulce* peel-mediated ZnO nanoparticles. *Journal of Molecular Structure*, (2023). *1273*, 134262.

Thirumalai, T., David, E., Therasa, S. V., and Elumalai, E. K. (2012). Restorative effect of *Pithecellobium dulce* root in CCl_4-induced hepatotoxicity in mice. *Asian Pacific Journal of Tropical Disease*, *2*(Suppl. 1), S239-S243.

Thwin, M. M., and Gopalakrishnakone, P. (2010). Snake venom inhibitors from marine and terrestrial resources. *Toxinology Handbook*, *21*, 1-25.

Vaidya, M. S., and Vishwakarma, J. Use of pharmacognosy to study *Pithecellobium dulce* (Roxb.) Benth. stem and leaves. *Journal of Pharmacognosy and Phytochemistry*, (2020). *9*(2), 1664-1666.

Vasanharaja, R., *et al.* (2023). Green synthesis of copper oxide nanoparticles using *Pithecellobium dulce* leaf extract and its antibacterial activity. *Materials Today: Proceedings*, *80*(2), 1587-1592.

Velayutham, K., Ramanibai, R., and Dahms, H. U. (2013). Adulticidal and repellent activity of *Pithecellobium dulce* against *Anopheles stephensi*. *Parasitology Research*, *112*(11), 3811-3819.

Verma, N., Amresh, G., and Sahu, P. K. (2012). Protective and therapeutic effects of *Pithecellobium dulce* in diabetic complications. *Asian Pacific Journal of Tropical Biomedicine*, *2*(3), S1236-S1241.

Yadav, R., *et al.* (2012). Investigation of the neuroprotective potential of *Pithecellobium dulce* in various animal models. *Toxicology and Industrial Health*, *28*(6), 547-557.

Zapesochnaya, G., Yarosh, E. A., Syanidze, N. V., and Yarosh, G. I. Flavonoids of the leaves of *Pithecellobium dulce*. *Khimiya Prirodnykh Soedinenii*, (1980). *16*(2), 252-253.

Zhang, Y., Li, X., and Wang, Z. (2022). Saponins from *Pithecellobium dulce* and their lipid-lowering potential. *Fitoterapia*, *157*, 105120.

Cite this article: Piramanayagam S, Muthu SP, Gopalan E, Veeramani C, Balraj S, Sivakumar R, *et al*. Phytochemical and Pharmacological Potential of *Pithecellobium dulce*: A Review. Pharmacog Res. 2027;19(1):10-20.