

Exploring the Health, Medicinal, and Therapeutic Potential of Manila Tamarind (*Pithecellobium dulce*)

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SUMMARY

Manila tamarind (*Pithecellobium dulce*), a tropical leguminous fruit, has gained attention for its potential health benefits due to its rich nutritional composition. This abstract reviews the bioactive compounds and associated therapeutic effects of Manila tamarind. The fruit is abundant in antioxidants, including flavonoids and polyphenols, which play a crucial role in combating oxidative stress and inflammation. Moreover, its high fiber content aids in digestive health, preventing constipation, and contributing to overall gut well-being. The fruit's antimicrobial properties also suggest its effectiveness against common bacterial and fungal infections. Additionally, the fruit's potassium and vitamin C content have cardiovascular and immune-enhancing effects, respectively. Preliminary studies also highlight its role in regulating blood glucose levels, offering potential benefits for diabetic management. Overall, Manila tamarind is a promising fruit with multifaceted health benefits, warranting more scientific exploration for therapeutic applications.

INTRODUCTION

Pithecellobium dulce is a local fruit used to treat many ailments by ancient people due to its extraordinary medicinal qualities. The entire tree, from root to fruit seems to be having one medicinal quality or other. It contains bioactive compounds such as sterols, flavonoids, triterpenoids, tannins and so on and seem to have disease preventing qualities such as antiviral, antibacterial, antioxidant, anti-diabetic, anti-pyretic, anti-helminthic, anti-inflammatory, and sedative activities which are still under investigation. The fruit also contains health promoting nutrients such as proteins, plant steroids, and carbohydrates. This review revolves around the various nutritional properties and incorporation of the fruit aiding in promoting value-added novel food (Roselin and Sakthivelan, 2022). It originated from Mexico, then went to America, Central Asia and then to India. Although, these trees have been seen all along the highways in India, no one knew about its culinary use. It resembles tamarind and is widely called as Manila Tamarind. It is an acrid eatable organic fruit for the most part utilize for cooking, contains high wholesome esteem and various medical advantages for body. Besides being a viable normal cure, it is more moderate contrasted with high cost medicines in clinics and restorative centers. Studies have concluded that hydro alcoholic fruit extract of *Pithecellobium dulce* (HAEPD) (Megha and Geetha, 2012)

P. dulce is one of the recognizable species, normally refer as manila tamarind, as its harsh taste takes after tamarind. The nonexclusive name is gotten from the Greek word as 'Pithekos' which means a chimp and lobos alluding to a unit and the animal categories name as 'dulce' in Latin methods sweet in inference to the consumable mash of the case. Due to the likeness of the natural products to the Indian sweet 'jalebi', the plant additionally is given the name 'jungli jalebi' (Nadkarni,1982). The bark and mash of Manila Tamarind is utilized as a conventional cure against gumailments, toothache, and discharge. Bark remove is additionally utilized against looseness of the bowels, the runs, and stoppage of stools (Kamatsile, 2014). The plant is well known for its edible fruits and they have been consumed for various ailments in a traditional manner. The fruits are linear, curved legumes (pods) that range in length from 10 to 13 cm. usually, single pod contains 10 seeds; pods are irregular in shape and flattened, set in spirals of 1 to 3 whorls and strangled between the seeds (lomentaceous). Seeds are black and shiny with 1 cm in diameter hanging in the pods by a red funicle. The pod is dehiscent on both sides (Orwa et al., 2009). The chemical composition of *Pithecellobium dulce* is quite complex, featuring a variety of biologically active compounds. Different parts of the plant, including the leaves, bark, fruits, seeds, and roots, are known to possess therapeutic properties and have been utilized by traditional healers.

Nutritional Values

The fruits and seeds of *P. dulce* contain vital vitamins like ascorbic acid, thiamine, riboflavin, and some essential amino acids like lysine, phenylalanine, tryptophan, and valine, as shown in Figure 3 and few essential minerals such as Na, K, P, Fe, and Ca, as shown in Figure 4 and secondary metabolite classes like tannins, 25.36%

fixed oil, and 18.2% olein are found in the *P. dulce* (CSIR, 1988). Catechol, a notable type of tannin compound which is present in the bark (37%). Quercetin, afezilin, kaempferol, and dulcitol were identified from the leaf extract of *P. dulce*. Its fruit contains phenols, flavonoids, and saponins. The phenolic and flavonoids have a hydroxyl functional group that possesses radical scavenging ability to prevent oxidative damage (Katekhaye and Kale, 2012).

Manilla tamarind pods and seeds are having high nutritive value. The aril contains different nutrient like moisture (75.8-77.8g), calories (78.8 K), ash (0.6 %), protein (12.47-23.3 g), fat (0.4-0.5 g), carbohydrate (18.2-76.87g), fibre (1.1-1.3 g), Ca (13-21 mg), P (42-58 mg), Fe (0.5-1.1 mg), Na (3.7-19mg), K (222-377mg), Mg (40 mg), Cu (0.6), S(109 mg), Vitamin A (25 IU /15mg), thiamine (0.24 mg), riboflavin (0.1 mg), niacin 0.6 mg, and ascorbic acid (13.8-33.0 mg). Beside these the aril contains different essential amino acids which are valine (143 mg), lysine (178mg), phenylalanine (41mg), and tryptophan (26mg). The seed contains 13.5 % moisture, 17.6 % protein, 17.1 % fat, 7.8 % fibre, 2.6 % ash, and 41.4 % starch (C.S.I.R., 1948–1976; Verheij and Coronel, 1991; Singh et al., 2012). Proteins and peptides with the potential to combat protein malnutrition are richly present in *P. dulce* seeds. The steroid, saponin, lipids, phospholipids, glycosides, glycolipids, and polysaccharides are present in *P. dulce* seeds. Recently, the alkylated resins were identified from the seed oil. The water-soluble polysaccharides were isolated from the seeds and are used as humanoid ailments; it also has an anti-oxidant activity that prevents the oxidative stress (Bagchi and Kumar, 2016). Three different hetero-polysaccharides are isolated from *P. dulce* fruits; those were used as pharmaceutical adjuvants (Preethi and Mary Saral, 2016). The entire plant of *P. dulce* has medicinal values and its leaves are also used as a feed for goat (Kahindi et al., 2007) because of its good nutritional content (Olivares et al., 2013). Manila Tamarind fruits are rich in various nutrients and antioxidants. Recent studies have also highlighted the nutritional benefits of Manila Tamarind, showing its richness in vitamin C, antioxidants, and dietary fiber (Ghate et al. 2018).

Medicinal Uses:

Various parts of *Pithecellobium dulce* are used for medicinal use:



Figurer 1: *Pithecellobium dulce* plant

Leaves: The leaves of *P. dulce* contain several key components, including cyclitol, dulcitol, octacosanol, α -spinasterol, kaempferol-3-rhamnoside, quercetin, and afzelin (Zapesochnaya et al., 1980) . Traditional literature indicates that these leaves are used in folk medicine to treat various ailments such as leprosy, intestinal disorders, peptic ulcers, toothaches, earaches, and as emollients, abortifacients, and larvicides (Megala and Geetha, 2010). When applied as a plaster, the leaves can help relieve pain from venereal sores and alleviate convulsions. Additionally, when consumed with salt, they are said to aid digestion, though they can also lead to abortion (Sunarjono and Coronel, 1991).

Fruit: The fruit of *Pithecellobium dulce* is noted for its nutritional and medicinal benefits. Its sweet flavor makes it a popular food source in various regions of India. Analysis using gas chromatography and mass spectrometry identified ten compounds in the fruit, including: (1) 2,5,6-trimethyl 1,3-oxathiane, (2) trans-3-methyl-2-N-propylthiophane, (3) 2-carboxaldehyde-5-(hydroxymethyl), (4) D-pinitol, (5) heptacosanoic acid, (6) hexadecanoic acid, (7) tetracosanol, (8) 22-tricosenoic acid, (9) methyl-2-hydroxy icosanoate, and (10) stigmasterol (Preethi and Saral, 2014). Traditionally, the fruit has been used to treat gastrointestinal issues, particularly peptic ulcers (Megala and Devaraju, 2015).

Seed: The seeds of *Pithecellobium dulce* contain 13 free amino acids, of which five—valine, histidine, threonine, and leucine—are essential, ranging from 0.46% to 4.69%. The protein in these seeds is particularly rich in tyrosine (4.7 mg) and leucine (2.4 mg) per 100 grams of defatted seed powder (Singhal, 2014). Recent studies have shown that the methanolic extract of *Pithecellobium dulce* seeds can be beneficial in treating diabetes and its associated complications. This has led to their traditional use for managing diabetes mellitus (Nagamothei et al., 2015).

Peel: The fruit peel of *Pithecellobium dulce* is traditionally used by local communities in the northwest region of Tamil Nadu, India, for diabetes management. Some individuals chew the raw peel or consume its decoction in water to help control blood sugar levels, although there is currently no scientific evidence to support these practices. Research conducted on the fruit peel has primarily focused on its antibacterial, antioxidant, and wound-healing properties (Sukantha et al., 2011; 2014). Additionally, studies have identified secondary metabolites from the fruit peel, including stigmasterol and sitosterol quercetin and pinitol which proved be the extract is viable drug target for diabetes mellitus (Sukantha et al., 2015).

Tree: The *Pithecellobium dulce* tree, as a whole is reported to be active against venereal diseases, the decoction also being given as enema and studies revealed that the phytochemical analysis of crude extract of bark the contained alkaloids, anthraquinones, tannins, terpenoids and sterol exhibiting significant antimicrobial activity, and thus confirming the traditional therapeutic claims of this plant (Nehra et al., 2014). The bark of the plant is reported to be used as an astringent for dysentery, febrifuge and is useful in dermatitis, eye inflammation and posses antivenomous activity (Pithayanukul et al., 2005; Kumari, 2017).

Roots: Scientific studies on roots of the *Pithecellobium dulce* tree are limited but, traditionally the roots were used in treating dysentery. In Haiti, root and bark decoctions are taken orally against diarrhea and in Guiana, root bark used for dysentery and as febrifuge (Orwa et al., 2009; Kamatsile, 2014).

Considering the above facts it is thought to be worthful to explore the possibility of beneficial effects and to review the therapeutic pharmacological actions of *Pithecellobium dulce*.

Therapeutic Values of *Pithecellobium dulce*.

Each part of the plant *P. dulce* contains notable medicinal values, like the estrogenic activity was proposed in the root extracts (Saxena et al., 1998), the anti-inflammatory activity of the saponin fraction of *P. dulce* fruits (Bhargvakrishna et al., 1970; Sahu and Mahato, 1994), and their various parts have been reported to be as a remedy for earache, leprosy, peptic ulcer, toothache, venereal disease, and it also acts as emollient, abortifacient, anodyne, and larvicides (Govindarajan et al., 2012).

Anti-Diabetic Activity

Diabetes mellitus is a complex and challenging metabolic disorder. Several chemical agents can help regulate insulin and glucose levels in the blood. This condition arises from either inadequate insulin secretion or ineffective insulin action in the body (Chaudhury et al., 2017). The *P. dulce* fruit containing a cyclic polyol pinitol and it has reported for having anti-diabetic activity (Gao et al., 2015; Kim et al., 2007).

Antioxidant Activity

In the human body, various mechanisms, including enzymatic and non-enzymatic antioxidants, protect cellular molecules and tissues from damage caused by reactive oxygen species (ROS) (Aruoma, 1998). Phytochemicals are well-known sources of antioxidant activity, helping to stabilize radicals generated by various factors and promoting antioxidant enzymes in our bodies. Extracts from the leaves, seeds, fruits, and bark of *P. dulce* demonstrate significant activity against free radicals. The entire plant exhibits strong free radical scavenging potential against synthetic radicals such as DPPH, nitric oxide, superoxide, and hydroxyl ions (Katekhaye and Kale, 2012; Nagmoti et al., 2012; Sukantha et al., 2011).

Anti-Bacterial Effect

The ethanolic extract of *P. dulce* pod pulp has been shown to effectively inhibit both Gram-positive bacteria (*Bacillus subtilis*) and Gram-negative bacteria (*Klebsiella pneumonia*). This antibacterial activity is attributed to secondary metabolites such as flavonoids and saponins (Pradeepa et al., 2014). Additionally, aqueous, methanolic, and ethyl acetate extracts of *P. dulce* fruit peel have demonstrated the ability to inhibit eight different microorganisms associated with wound infections, including *Staphylococcus epidermidis*, *Escherichia coli*, *Klebsiella pneumonia*, *Staphylococcus aureus*, *Enterococcus faecalis*, *Pseudomonas aeruginosa*, *Pseudomonas putida*, and *Proteus vulgaris*. The crude methanolic extract showed the highest zone of inhibition. These results suggest that metabolites from *P. dulce* fruit peel could serve as effective antimicrobial and wound healing agents. Furthermore, the ethanolic extract of *P. dulce* leaves has also been studied, and its antibacterial properties have been reported by Sukantha et al., 2014.

Antifungal Activity

The aqueous and hydroalcoholic extracts of *P. dulce* exhibit significant activity against contamination by *Rhizopus stolonifer*, *Botrytis cinerea*, and *Penicillium digitatum*. In the aqueous extract, the secondary metabolite kaempferol, along with other compounds, plays a key role in combating fungal contamination. When comparing the two types of extracts, the aqueous extract demonstrates superior effectiveness against fungal contamination (Bautista-Banos et al., 2003; Shanmugakumar et al., 2006).

CONCLUSION:

Pithecellobium dulce is recognized for its significant health-promoting, disease-preventing, and life-extending properties, as documented and validated by contemporary researchers. This article provides a thorough overview of the physiological and pharmaceutical properties of *P. dulce*, as well as its traditional applications. Furthermore, this study promotes the consumption of traditionally used herbs and fruits as a way to address modern, life-threatening illnesses.

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