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Potential health benefits of manila tamarind

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Abstract
Pithecellobium dulce has been utilized by antiquated individuals in treating various sorts of ailments due to its restorative properties. The bark and pulp being astringent and haemostatic are used to treat gum ailments, toothache and bleeding. Bark extracts are used for chronic diarrhea, dysentery, constipation and tuberculosis. Extract of leaves is employed as a remedy for indigestion and to prevent spontaneous abortion and for gall bladder ailments and to treat both open and closed wounds. Ground seed is used for treating ulcers. Studies also shows that it might help in curing diabetes, inflammation, cancer, tuberculosis, venereal diseases, bilious disorders, fever, cold, sore throat, malaria, skin pigmentation, acne and pimples, dark spots, conjunctivitis, irritable bowel syndrome, pain, eczema, pan ophthalmitis, leprosy. Studies have evaluated its antioxidant, anti-hyperlipidemic, anti-septic, anti-bacterial properties.

Keywords: *Pithecellobium dulce*, treatment for constipation, fever, sore throat, anti-bacterial, abortifacient

Introduction
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) [1] can be used safely for experimental and clinical trials. This study was carried out to evaluate acute and sub-acute toxicity profile of HAEPD in 2010. According to the studies performed in 2012, scientists have validated the anti-microbial potential of traditionally important plant, *Pithecellobium dulce* [2]. The bark and pulp of Manila Tamarind is used as a traditional remedy against gum ailments, toothache, and hemorrhage. Bark extract is also used against dysentery, diarrhea, and constipation. An extract of leaves is used for gall bladder ailments and to prevent miscarriage. Seeds when grounds are used to cleanse ulcers. Numerous studies have been performed on anti-oxidant, anti- inflammatory, anti- diabetic, anti- cancer properties of Manila tamarind. It provides relief from pain, eczema, fever, cold, sore throat, pigmentation, acne and pimples.

Biological sources and botanical name: *Pithecellobium dulce*
Family Name: Leguminosae
Parts Used: Bark, leaves, seeds, flowers, pulp
Common Name: Vilayati imli, Jungli jilebi
Marathi: Ingraji chinch
Tamil: Kodukka Puli
English: Manila Tamarind, Monkey pod, Madras thorn.

Chemical constituents
Tannin, 25.36%; fixed oil, 18.22%, olein. A glycoside quercetin has been isolated. Seeds have been reported to contain steroids, saponins, lipids, phospholipids, glycosides, glycolipids and polysaccharides. Bark yields 37% tannins of the catechol type. Leaves yield quercetin, kaempferol, dulcitol and afezilin. Fatty acid analysis of seed extract yielded 9 saturated and 17 unsaturated fatty acids. Total protein content was highest in the seeds (50.3-67.1%), followed by stems, roots, leaves, flowers, and fruits. Ethanolic extract of fruits yielded ten compounds viz. (1) 2, 5, 6-trimethyl 1, 3-oxathiane, (2) trans-3-methyl-2-Npropylthiophane, (3) 2-furan

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. Evaluation of seed protein flour showed a protein content of 39.22%, calcium 48 mg, and phosphorus 542 mg/100 g. Major amino acids were glutamic acid, arginine, aspartic acid, lysine, valine, threonine and leucine. Ratio of essential to nonessential amino acid was 0.61. Total polyphenol content was 294 mg/100g. GC-MS study of leaves yielded bioactive constituents: phytol, anthracene, 9(3butenyl), diisooctyl phthalate, 13docosenamide, 3, 6, 9-triethyl3,6,9trimethyl formic acid, cyclotetrasiloxane, octamethyl, ascorbic acid 2,6dihexadecanoate.

Nutritional value of manila tamarind

Energy -78 kcal, Water -77.8%, Protein- 3%, Fat- 4%, Carbohydrate- 18.2%, Fiber- 1.2%, Ash -6%, Calcium- (1.3% RDI) 13 mg, Phosphorous- (4.2% RDI) 42mg, Iron- (2.7% RDI) 5mg, Sodium -19mg, Potassium- (6.3% RDI) 222mg, Vitamin A- 15mg, Thiamin/B1- (16.6% RDI) 24mg, Riboflavin/B2- (5.8% RDI) 10mg, Niacin/B6- (3% RDI) 60mg, Vitamin C- (221% RDI) 133mg.

Medicinal uses

Anti-Inflammatory / Antibacterial

Study of the fresh flowers of *Pithecellobium dulce* yielded a glycoside quercitin. The activity of the flavonol glycoside confirmed its anti-inflammatory and antibacterial properties.

Antioxidant

Study of the aqueous extract of *Pithecellobium dulce* leaves revealed phenolics including flavonoids and showed potent free radical scavenging activity.

Anti-inflammatory triterpene saponins of *Pithecellobium dulce*

A new bis desmodic triterpenoid saponin, dulcin, was isolated from the seeds of PD.

Anti-tuberculosis / Antimicrobial

Hexane, chloroform and alcoholic leaf extracts were studied for activity against *Mycobacterium tuberculosis* strains. The alcoholic extract showed good inhibitory activity and antimicrobial activity against secondary pathogens [2].

Anti-Diabetic

Study of ethanolic and aqueous leaf extract of P dulce in STZ-induced diabetic model in rats showed significant activity, aqueous more than the alcoholic extract, comparable to glibenclamide [9].

Anti-Ulcer

Study of the hydroalcoholic extract of PD was found to possess good antioxidant activity and suggests possible antiulcer activity with its free-radical scavenging and inhibition of H, K-ATPase activities comparable to omeprazole. Phytochemical screening yielded flavonoids - quercetin, rutin, kaempferol, naringin, daidzein [10].

Hepatoprotective

Study of an aqueous extract of *P. dulce* in a murine model showed hepatoprotection against CCl4-induced oxidative impairments probably through its antioxidative property. Results were supported by histological findings [11].

CNS Depressant

Study evaluating the locomotor activity of aqueous and alcoholic extracts of PD in albino mice showed significant CNS depression, the alcoholic extract exhibiting greater effect when compared to chlorpromazine. The activity was attributed to an increase in the concentration of GABA in the brain.

Analgesic / Anti-Inflammatory

Study of methanol extract showed significant anti-inflammatory and analgesic effects comparable to standard drugs.

Hypolipidemic

Study evaluated the anti-hyperlipidemic activity of an aqueous extract of leaves against triton induced hyperlipidemia in rats. Results showed lipid effects with a decrease in total serum cholesterol, LDL, and an increase in serum HDL cholesterol level-12.

Adulticidal

Study evaluated the Adulticidal activity of various solvent leaf and seed extracts against *Culex quinquefasciatus*. Results showed the crude extract of *P. dulce* has excellent potential for controlling filiariasis vector mosquito Cxquinquefasciatus.

Antimicrobial

Study evaluated the antimicrobial activity of leaf of *P. dulce* against 20 pathogenic microorganisms. Results showed extracts possess bioactive compounds with significant antimicrobial activities**.**

α-Glucosidase and α-Amylase

Study evaluated bark and leaves of *P. dulce* for a-amylase and a-glucosidase inhibition *in vitro*. a-amylase and a-gluscosidase inhibitors from food-grade plant sources offer an alternative approach for the treatment of post-prandial hyperglycemia by decrease glucose release from starch and delaying carbohydrate absorption. Results confirmed a-glucosidase and a-amylase inhibitory activity of a methanol and ethanol extract.

Skeletal muscle relaxant / CNS depressant

Study showed an acutely administered single dose of aqueous and ethanolic extracts of leaves possess skeletal muscle relaxant activity and CNS depressant activity but no anticonvulsant action.

Larvicidal & ovicidal against mosquito vectors

Study evaluated various extracts of *P. dulce* for larvicidal and ovicidal potential against mosquito vectors, *Anopheles stephensi* and *Aedes aegypti*. All leaf and seed extracts showed moderate larvicidal and ovicidal effects; however, the methanol extract of leaf showed the highest larval activity. Results suggest the seed and leaf extracts have potential as an eco-friendly option for mosquito vector control [13].

Anti-Diabetic / Fruits

Study evaluated the antidiabetic potential of *P. dulce* fruits in STZ-induced experimental diabetes in rats. Results showed significant reduction in blood glucose, glycosylated hemoglobin, urea and creatinine. There was also improved glycogen contact upon treatment with the extract.

Cardio protective / Fruit Peel
Study evaluated the effect of *P. dulce* peel in isoproterenol (ISO) induced myocardial infarction in adult male Wistar rats. ISO induced MI in rats showed increase in marker enzymes. Pretreatment PD fruit peel extracts positively altered the activities of marker enzymes and biochemical parameters in ISO-induced rats [14].

Anthelmintic / Leaves
Study evaluated leaf extracts of *P. dulce* in three different concentrations for anthelmintic activity against *Pheretima posthuma*. The aqueous extract was more potent than the alcoholic extract, with activity comparable to the reference drug piperazine citrate.

Adulticidal / *Aedes aegypti*
Study evaluated the toxicity and mosquito Adulticidal activity of different solvent leaf and seed extracts of *P. dulce* against dengue vector, *Aedes aegypti*. Among tested solvents, the leaf and seed methanol extract showed maximum efficacy.

Antiulcer / Fruits
Study evaluated the antiulcer activity of hydro alcoholic fruit extract of *Pithecellobium dulce* on a cyst amine induced duodenal ulcer model in male albino Wistar rats. Rats pre administered with HAEPD showed significantly reduced ulcer score compatible to that of ranitidine pretreated rats. Results showed antioxidant and cytoprotective antiulcer activity.

Nanoparticles / Fruits
Study reported on the biosynthesis of titanium dioxide nanoparticles using *Pithecellobium dulce* and *Lagenaria siceraria* aqueous leaf extract. The nanoparticles synthesized by biological method showed a higher antioxidant potential and antimicrobial activity than chemically synthesized.

Polysaccharides / Antioxidant
Study secluded water-soluble PDP polysaccharides from *P. dulce* seeds. Fractions were tested for *in vitro* antioxidant capacities by DPPH, h2O2 and reducing power assay. Results showed activity in a dose dependent manner comparable to standard ascorbic acid.

Antibacterial
The leaf extract of *P. dulce* showed good inhibition against gram positive organisms. The highest inhibition was noted S. epidermidis (24mm), P. acne (14mm), and S. aureus (11mm).

Antidiarrheal
Study evaluated the antidiarrheal effect of an ethanol extract of *Pithecellobium dulce* using castor oil induced diarrhea in rats. Results showed a dose dependent antidiarrheal effect (p<0.01) more effective than Loperamide, the standard antidiarrheal drug [15].

Inhibitory Effect on Intestinal α-Glycosidase and Pancreatic α-Amylase / Seeds
Study of a methanolic extract of seeds showed inhibitory action on α-amylase and α-glucosidase enzymes. Activity may be attributed to their phenolic and triterpene constituent such as Oleanolic acid. Results suggest a potential for a function food that can modulate key carbohydrate hydrolyzing enzymes to be of use in the management of diabetes, especially in the control of postprandial hyperglycemia [16].

Health benefits
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 anti-oxidant property.

Manla tamarind contains
Vitamin E: This contributes to aging.
Vitamin B1: This helps to nourish the nerves and the brain.
Vitamin B2: This contributes to the skin, nails and hair health.
Vitamin B3 (niacin): Which contributes to decrease levels of cholesterol.
Calcium: This helps to give a boost to bones and enamel.
Phosphorus: This contributes to the expansion and restoration of body.
Iron: This contributes to the prevention of fatigue of the body.

Conclusion
Present review focuses on nutritional and health benefits of Manila Tamarind. Manila Tamarind is a good source of carbohydrate, fiber, protein, and bioactive components giving it promising nutritional and health beneficial properties. Major health beneficial properties of manila tamarind like antidiabetic, antioxidant, anti-bacterial, cardio protective, antidiarrheal, have been discussed in this review article. Based on these medicinal properties, as reported by scientific findings, Manila Tamarind can be recommended and can be made a part of our daily diet as its liberal use is safe and various health benefit can be drawn from this natural herb.

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