Available online on 22.08.2019 at http://jddtonline.info

Journal of Drug Delivery and Therapeutics

Open Access to Pharmaceutical and Medical Research

Open Access Review Article

Review on Pharmacological potentials of *Prosopis juliflora*

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ABSTRACT

Prosopis juliflora is one of the most widely used herbal plants in treating diabetes mellitus. This plant mainly belongs to the *Leguminosae* (Mimosaceae) family. The World Health Organization (WHO) estimates that about 80% of the population is still depends upon herbal medicines for their treatment of diseases due to various advantages such as ease of availability, economic and less side effects when compared to allopathic system of medicines. This plant has broad ecological amplitude and is adapted to a wide range of soils. It is generally found in the areas where water and soil fertility are the primary agents limiting plant growth, and is able to survive, and even thrive, on some of the poorest land, unsuitable for any other tree species. The phytoconstituents present in this plant are tannins, phenolics, flavonoids, alkaloids, terpenes and steroids. This plant shows various pharmacological activities such as anti-bacterial, antifungal, anticancer, antioxidant, and antimicrobial activity. The review of this plant suggests that the presence of flavonoids, phenolic compounds, alkaloids and other secondary metabolites are responsible for its pharmacological activities there for, the plant plays a vital role in maintenance of the human health and wellbeing. The present review deals with various pharmacological effects established on plant *P. juliflora*.

Keywords: *Prosopis juliflora*, Alkaloids,

Article Info: Received 13 June 2019; Review Completed 31 July 2019; Accepted 10 August 2019; Available online 22 August 2019

Cite this article as:

Ukande MD, Shaikh S, Murthy K, Shete R, Review on Pharmacological potentials of *Prosopis juliflora*, Journal of Drug Delivery and Therapeutics. 2019; 9(4-s):755-760 http://dx.doi.org/10.22270/jddt.v9i4-s.3372

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Introduction

The medicinal plants are widely used as a source of the medicine. The widespread use of herbal remedies and healthcare preparations is described in the Vedas and the Bible. The plants having the medicinal value have been used for several years in the conservation of food and also used to treat health disorders and also to prevent health related diseases.[1] *Prosopis juliflora* is one of the most economically and ecologically important tree species in arid and semi-arid zones of the world.[2]

Prosopis juliflora belongs to the family Leguminosae (Fabaceae), sub-family Mimosoideae, and it having 44 species of which 40 are native to the Americas, three to Asia and one to Africa. The tropical Andean region is home to six species and eight species are found in the texas area, seven of them being endemic.[3] These species are having the several properties such as soil binders, sand stabilizers, as well as its ability to grow in the poorest soils.[4]

Botanical Description

It is a shrub or tree having 8-12 metres long. Growing to a height of up to 12 metres (39 ft), *P. juliflora* has a trunk diameter of up to 1.2 metres (3.9 ft).[5] Its leaves are deciduous, geminate-pinnate, light green, with 12 to 20 leaflets. Flowers appear shortly after leaf development. The flowers are in 5–10 cm long green-yellow cylindrical spikes, which occur in clusters of 2 to 5 at the ends of branches. Pods are 20 to 30 cm long and contain between 10 and 30 seeds per pod. A mature plant can produce hundreds of thousands of seeds. Seeds remain viable for up to 10 years. The tree reproduces solely by way of seeds, not vegetative. Seeds are spread by cattle and other animals, which consume the seed pods and spread the seeds in their droppings.[6] The tree is said to have been introduced to Sri Lanka in the 19th century, where it is now known as *vanni-andara*, or *katu andara* in Sinhala. It is claimed that *P. juliflora* existed and was recognized even as a holy tree in ancient India, but this is most likely confusion with Prosopis cineraria. The tree is believed to have existed in the Vanni and Mannar regions for a long time.[7,8] In the western extent of its range in Ecuador and Peru, *Prosopis juliflora* readily hybridizes with *Prosopis pallida* and can be difficult to distinguish from this similar species or their interspecific hybrid strains.[9] Tap roots contribute to a stable anchoring of the tree and expand towards ground water reserves. They are essential during periods of drought when only deep water sources are available. The depth of the roots depends on the quality and structure of the soil and the availability of soil water; it is also determined by the density of the stand.

Fig 1: Mesquite: *Prosopis juliflora*

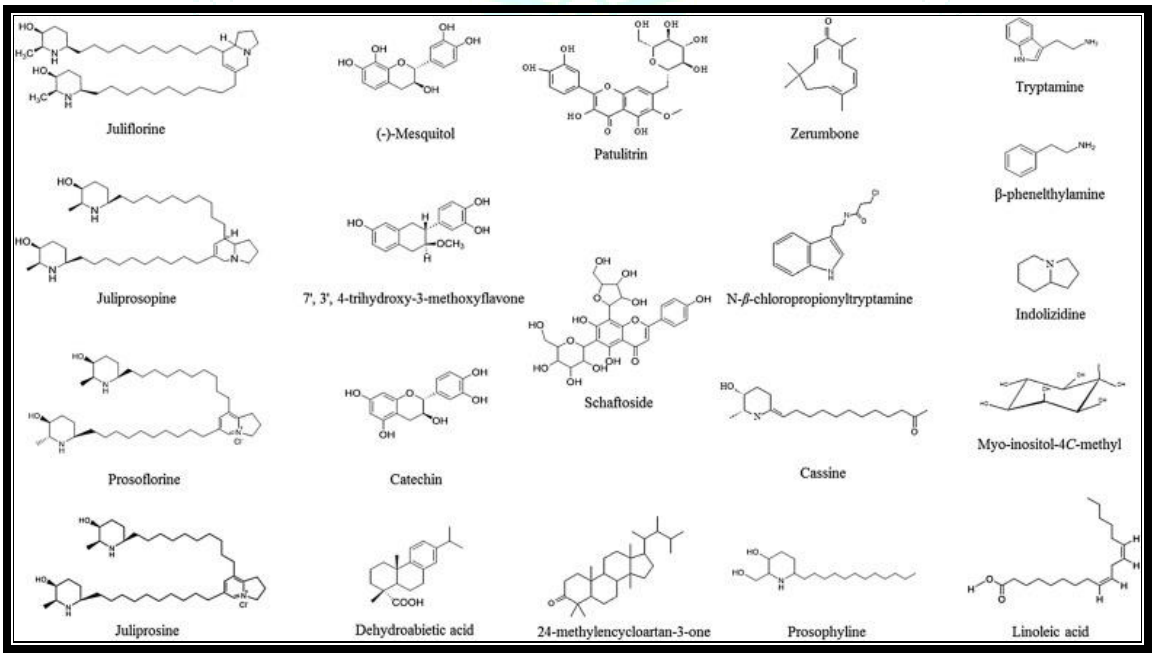

Fig 2: Chemical structures of Prosopis spp. having medicinal properties.

Beneficial impacts of *P. juliflora*

The various chemical agents that are present in it show the medicinal value that may alters certain physiological actions in the human body. The several biochemicals present in the plant are terpenes, alkaloids, flavonoids and phenolic compounds. Terpenes are used as insecticides and their pharmacological properties include antibacterial, antifungal, anthelmintic, antimalarial and molluscicidal.[10] Extracts of *P. juliflora* seeds and leaves have several in vitro pharmacological effects such as anti-bacterial, anti-fungal and anti-inflammatory properties.[11]

Scince it is a main source of fuel for both urban and rural poor in the country, this plant provides more than 90% of the fuel wood in some Indian villages because *P. juliflora* wood has excellent burning qualities. Thus, it is called wooden anthracite. It also has high calorific value. The wood obtained from this plant doesn't need storage and drying process.[12]

It also contains high flavonoidal content 16% which shows the antioxidant and anticancer properties. The tannins and phenol content is very low i.e. (0.33 and 0.66% respectively) which can synergize the antioxidant and anticancer potential

of flavonoids. Phenols showed the property to prevent the platelets from clumping and also have anti-inflammatory properties. It also acts as immune enhancer, anticlotting and hormone modulators. Tannins in the plant cell inhibit hydrolytic enzymes like proteolytic macerating enzymes used by plant pathogens.[13, 14]

This plant also helps in preventing the fungal and mycotoxin contamination. Therefore there is an absolute need for bioactivity guided fractionation and isolation of the active components from the plant extracts found to be effective.[15]

Table1. Promising bioactive botanicals from *P. juliflora*

Name of compounds	Class of compound (source)	Pharmacological activity
Mesquitol	Flavonoid (Bark)	Antioxidant
Juliflorine	Alkaloid (Leaves)	Antialzheimer agent
Seco-juliprosopinal	Alkaloid (Leaves)	Plant growth inhibition
Juliprosine	Alkaloid (Leaves)	Antifungal agent
Isojuliprosine	Alkaloid (Leaves)	Antifungal agent
Juliprosinene	Alkaloid (Leaves)	Antibacterial agent

Pharmacological activities of *Prosopis juliflora*

Antibacterial Activity

The several alkaloid constituents present in the *Prosopis juliflora* were assessed for their antibacterial property using disc diffusion method on several *Gram-negative* and *Gram-positive* bacterial strains like *E.coli*, *Staphylococcus aureus*, etc. The maximum antibacterial effect is shown by the part of the plant such as leaf, pod and flower extract, with MIC [Minimum inhibitory concentration] value ranging between 25µg/ml-100µg/ml. The extract of leaves showed the maximum activity among of all the other parts.

The bacteria such as *Klebsiella* was found to be the most susceptible bacteria, whereas *Acinetobacter* and *Alcaligen* were the least susceptible. These bacteria affected by the alkaloidal extract of the plant while it is not affected by the use of antibiotics.[16]

Antifungal Activity

The aqueous extract of the leaves are involved in showing the fungicidal activity either by using in the combination or used alone. The aqueous extract exhibited maximum fungicidal activity at 24% concentration. Methanol and ethanol extracts recorded highly significant antifungal activity.[17] It was reported that this plant contains a variety of alkaloids having different biological activities including broad spectrum antifungal activity against a wide range of seed-borne fungi.

The combination of chemical fungicides amended with alkaloid extract showed highly significant antifungal activity compared to chemical fungicides alone tested at the recommended dosage.[18]

Antagonistic Effect

The methanolic crude extract of *P. Juliflora* showed the inhibition of the bacteria. The well diffusion test was performed on two tested *Gram-negative* bacteria (*E. coli* and *Klebsiella sp*.) and three *Gram-positive* bacteria (*Staphylococcus aureus, Bacillus sp.* and *Streptococcus sp*.) indicated inhibition of all tested bacteria. The leaves extract of this plant showed the inhibition on all tested bacteria with 22 and 19 mm zone of inhibition against *Streptococcus sp*., and *Bacillus sp*., respectively, whereas dry leaves revealed intermediate inhibition.[17]

Anti-Tumor Activity

Several alkaloid extracts are involved in showing the cytotoxic activity. The in vitro anti-tumor potential of the extract was evaluated using MTT (3-(4,5- dimethythiazol-2yl) 2,5- diphenyl tetrazolium bromide) based cytotoxicity monitoring after 24, 48 and 72 h exposure of the MOLT-4 cells (1×106 cells/ml medium) to different concentration of the extract ranging from 10 to 100 µg/ml medium. The extract exhibited comparatively higher toxicity towards the cancer cells than the normal cells at all the tested concentrations and at all the time points studied.[19]

Prosopis juliflora (Sw.) DC contains many alkaloids such as juliflorine, julifloricine and julifloridine, juliprosine, juliprosinine and juliflorinine are found to be responsible for the biological activity.[20]

Anti-oxidant Activity

It has been reported that several flavonoids as well as phenolic acid contents and profiles play a significant role in determining the particular antioxidant capacity of pollen of different botanical origin. Compounds possessing reactive phenolic hydroxyl groups are endowed with an important antioxidant property in vitro particularly those possessing the O-dihydroxyl structure in 30th and 40th position of the B ring in the structure of flavonoids.[21] The antioxidant capacity as lipid peroxidation inhibitor in in vitro biological systems of mesquite honeybee-collected pollen is as high as that of pollen of *Amaranthus hybridus* and that of a complex mixture of honeybee-collected pollen formed by six monofloral pollens from Durango, Mexico, analyzed under similar conditions,[22] all of them with a particular flavonoid composition.

Anti-diabetic activity

Many anti-diabetic plants have a necessary role to treat diabetes mellitus because they have a strong action to decrease hyperglycemia. The terpenes isolated from this plant are generally used in the management of diabetes. The medicinal value of plants can be observed from the chemical agents they possess, which may alter certain physiological actions in the human body. The most important of these biochemically active compounds of plants are terpenes, alkaloids, flavonoids and phenolic compounds. Terpenes are used as insecticides and their pharmacological properties include antibacterial, antifungal, antimalarial and molluscicidal.[23]

Anthelmintic Activity:

The plant part of *P.juliflora* mainly roots and leaves have shown the Anthelmintic activity against adult *Haemonchus contortus*, with activity comparable to Albendazole, a synthetic anthelmintic drug. The anthelmintic activity

performed by Egg Hatch Assay and *In vitro* Ovicidal Activity. Ethanolic extracts of root (REE) and leaf (LEE) of *P. juliflora* were found to exhibit in vitro activity against adult *Haemonchus contortus*, with activity comparable to Albendazole, a synthetic anthelmintic drug. The anthelmintic activity of LEE was significantly higher than REE (P≤0.05) but lower than ALB. The observed in *vitro* anthelmintic activity was attributed to saponins and condensed tannins and perhaps to alkaloids present in the plant. Phytochemical analysis confirmed presence of tannins, saponins and alkaloids, among other phytoconstituents.[24]

Antipyretic Activity:

The ethanolic extract of the plant *Prosopis juliflora* has shown its potential, effective and safer anti-pyretic activity. To examine antipyretic activity male rats divided into four groups. Group 1 was treated with water for injection (100 ml/kg). Group 2 treated with Paracetamol (150 mg/kg p.o dissolved in water for injection). Group 3 and 4 were treated with ethanol extract of *Prosopis juliflora* (250 and 300 mg/kg p.o respectively). In this activity paracetamol was used as the standard drug in which the rectal temperature was reduced at 3 hours and at dose 500 mg/kg. Significantly reduced the rectal temperature at 2, 3 and 4 hours in comparison with vehicle control.[25]

Antiulcer Activity:

The ethanolic extract of the plant *Prosopis juliflora* examined for the antiulcer activity in wistar rats. The rats divided into four groups. Group 1 was treated with water for Injection (10 ml/kg). Group 2 was treated with Ranitidine (50 mg/kg p.o dissolved in water for Injection). Groups 3 and 4 were treated with ethanol extract of *Prosopis juliflora* (250 and 500 mg/kg p.o. respectively). The ethanolic extract of the plant *Prosopis juliflora* (250 and 500 mg/kg) significantly shows the reduction of the ulcer score in comparison with ethanol induced ulcer control.[26]

Antigiardial and Amoebicidal Activity:

Giardiasis is the most common cause of parasitic gastro-intestinal disease. Giardia is a flagellate protozoan with worldwide distribution that causes significant gastrointestinal diseases in a wide variety of vertebrates including cats and human. The highest activity against *Giardia lamblia*, with respect to time, was obtained from petroleum ether extract which exhibited 78.91% mortality within 72 h with a concentration of 500 ppm followed by the methanolic extract which exhibited 77.48% mortality within 72 h with a concentration of 1000 ppm. The highest activity against *Entamoba histolytica*, with respect to time, was obtained from methanolic extract which exhibited 71.97% mortality within 72 h with a concentration of 1000 ppm.[27]

Antipustule Activity

The Acetone extract of plant *Prosopis juliflora* (AEP) shows the effective anti-pustule activity by inhibiting *Staphylococcus* species through well diffusion method. Minimum inhibitory concentration of AEP showed the activity. This inhibitory action was also confirmed by growth curve analysis.[28]

Table 2. Medicinal effects of bioactive substances from parts of the *Prosopis spp* (Leguminosae, Mimosaceae).

Prosopis species	Prosopis species	Medicinal effects	Bioactive components	Ref
P. juliflora	Leaves	Inhibition of acetyl cholinesterase Blocking calcium channels	Juliflorine	29
	Leaves, pods	Decreasing gas production during ruminal digestion	Juliprosopine Prosoflorine Juliprosine	30
	Fruits	Activity against lung carcinoma	Patulitrin	31
	Heart wood	Antioxidant activity	()-Mesquitol	32
	Leaves	Inhibition of drug-resistant fungi Glial cell activation	Piperidine alkaloids	33
	Seeds, leaves	Inhibition of H+, K+, ATPase of H. pylori	Alkaloids, flavonoids, tannins, anthraquinones, and quinones	34
P. cineraria	Pods	Antioxidant activity	Triterpenoids Prosophyline	35
Prosopis africana	Leaves, roots and Stem	Antitripanosomal activity	Tannins	36
	Stem bark	Anti-inflammatory activity	Flavonoids	37
P. chilensis	Leaves	DNA binding activity	b-phenethylamine Tryptamine	38
Prosopis glandulosa var. *glandulosa*	Leaves	Anti-infective	Indolizidine	39
		Antiparasitic	Indolizidine	40
Prosopis flexuosa	Aerial parts	Antioxidant activity	Catechin	41
Prosopis tamarugo	Leaves	Antioxidant activity	Catechin	42
P. alpataco	Seed	Antibacterial activity	Pentacyclic triterpenes	43
Prosopis pallida	Fruit	Antihyperglycemia	Phenolic compound	44
P. cineraria	Whole plant	Anticonvulsant activity	Alkaloids	45

Medicinal applications of *Prosopis juliflora*[46]

- The syrup obtained by the ground up pods having the medicinal values.
- It is given to the children in weight deficiency or retardation in motor development.
- It is also involved in increasing lactation.
- It is used for preparing various medicinal syrups, particularly for expectorants.
- The leaves of the plant are used in the treatment of oral infections, painful and frequent urination.
- The powdered leaves are brewed in water and the liquid applied to the eyes to treat irritations, conjunctivitis etc.
- A compress made from the boiled leaves is applied to the eyes to reduce swelling.
- Tea made from *Prosopis juliflora* is thought to be good for treating digestive disturbances.
- The leaves have been shown to have antibacterial, antibiotic, antispasmodic and astringent properties.

Conclusion

Prosopis juliflora possess versatile medicinal properties. *Prosopis juliflora* has been proved to be effective as anthelmintic, antioxidant, antipyretic, antiulcer, cytotoxicity effect, antigiardial, amoebicidal, antipustule activity and many more. Hence in this review article effort has been taken to collect and compile the details regarding Prosopis *juliflora*, which will be useful to the society to venture into the further unrevealed pharmacological actions of *Prosopis juliflora* and also venture into the field of alternative system of medicine. The plant is a rich source of natural constituents, especially for flavonoids, alkaloids and saponins. *Prosopis juliflora* which is also known as mesquite locally has various pharmacological actions which can contribute a lot to the world's health as herbal plant. Various parts of herbal plant *Prosopis juliflora* are used like leaves, bark, twigs, flowers, fruits and pods in treatment for various therapeutic effects.

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