

Prosopis Spicigera: A Nature's Gift

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Abstract

The *Prosopis spicigera* Linn. is locally known as Khejri one of the most common medicinal plant of the Indian desert. The plant is very useful and famous especially in desert area due to its spread ability and importance. The plant is known as "Golden tree" or "Wonder tree" of the desert. It is an important herbal plant as mentioned in ancient literature. It is used traditionally in the treatment of various infirmities like leukoderma, leprosy, asthma, dyspepsia etc. The numbers of phytoconstituents like tannins, steroids, flavone derivatives, alkaloids etc. has been isolated from the plant. Pharmacological activities like anti-inflammatory, anticonvulsant, antifungal, anticancer, antidiabetic, hypolipidemic, abortifacient, antioxidant, antimicrobial and wound healing properties have been reported of different plant extracts. The present review deals with phytoconstituents and potential pharmacological activities of *Prosopis spicigera*.

Keywords: *Prosopis spicigera*, Shami, Wonder tree.

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Introduction

The medicinal uses of plant in the treatment of various human infirmities are referenced in Ayurveda and other traditional medicinal systems. The *Prosopis spicigera* Linn. belongs to family Fabaceae (Leguminosae) is small to moderate sized plant. The genus *Prosopis* has around 45 species of spiny trees and shrub. It is extensively spreading, densely branched, spiny tree or mainly a big tree of up to 25 m height. It is a tree to 6.5 m high with cinereous cortex with inter modal prickles, scattered, straight and somewhat macroscopic and with conical broad bases. It produces new flush leaves before summer. The flowers appear small in size and yellow or creamy white in color; appear from March to May after the new flush of leaves. The pods formed soon thereafter and grow rapidly in size, attaining full size in about two months' time(1). The *Prosopis spicigera* and other species have originated from North West India. It exists in dry regions of Central and Southern India, particularly, Western Rajasthan, Punjab, Gujarat, Maharashtra (near to the Nashik), Andhra Pradesh, and Karnataka south of Godavari. The plant is native to arid portions of Western Asia and the Indian Sub-continent, including Afghanistan, Iran,

India, Oman, Pakistan, Saudi Arabia, the United Arab Emirates and Yemen. There are various common names for the plant. In Hindi and Sanskrit, it is known as Khejri and in Rajasthan known as Janti/Loong tree. In Punjab it is known by the name of Jand and in Gujarat is known as Sami, Shami in Marathi(2). In Sind, it is known as Kandi. It is also known as "wonder tree" and "king of desert" as all the parts of a tree are useful. It is a small spike, irregularly branched tree, thick, rough gray bark with deep fissures. The roots are very deep; the tap root of the plant may penetrate vertically up to 20 m or more(3,4). The leaves form good food stuff for goats, camels and donkeys. The flowers are useful for honey production and pods are used as a vegetable. The Khejri is also used for soil improvement and sand dune stabilization. The bark of the tree has abortifacient and laxative properties. Khejri is reputed for the treatment of asthma and worm(5).

Phytochemistry: The whole plant contains methyl heptacosanoate, heneicosanoic acid, 4-hydroxy benzoic acid, methyl 4-hydroxycinnamate, methyl 2-methoxy-5-hydroxycinnamate and O-Coumaroylglycerol(6). The seeds contain prosogerin C(7), prosogerin D(8), prosogerin E, gallic acid, patuletin, patulitrin, luteolin, and rutin(9,10). The seed contains relatively large proportion of unsaturated fatty acids, with linoleic and oleic acids(11). Patulitrin has been reported significantly cytotoxic active against in vivo Lewis lungs carcinoma(12). Alkaloidal mixture extracted from *Prosopis spicigera* reported to cause bradycardia and immediate mortality in dogs at a dose of 1mg/kg(13). The flowers contain patuletin glycoside patulitrin(14),

sitosterol, spicigerine, flavone derivatives Prosogerin A and Prosogerin B(15).

Dried pods contain 3-benzyl-2-hydroxy-urs-12-en-28-oic acid, maslinic acid 3-glucoside, linoleic acid, prosphylline, 5, 50-oxybis-1,3benzendiol, 3, 4, 5, trihydro-xycinnamic acid, 2-hydroxy ethyl ester and 5, 30, 40-trihydroxyflavanone 7-glycoside(16). Hydroxycinnamic acid and coumaric acid derivatives have been reported to possess antioxidant properties and are believed to reduce the risk of stomach cancer by reducing the formation of carcinogenic nitrosamines(17).

The leaves contain steroids like campesterol, cholesterol, sitosterol and stigma sterol, actacosanol, hentriacontane, methyl docosanoate, Diisopropyl-10,11-dihydroxyicosane-1,20-dioate, Tricosan-1-ol, and 7,24-Tirucalladien-3-one along with a piperidine alkaloid spicigerine(18,19). Steroids like b-sitosterol, campesterol, sitosterol and stigmasterol reduce blood levels of cholesterol; also possess potent antioxidant, hypoglycemic and thyroid inhibiting properties(20).

Pharmacological Activities

Antitumor Activities: Hydro alcoholic extracts of leaves and bark were evaluated for antitumor activity against Ehrlich as cites carcinoma tumor model. The activity evaluated using survival time, peritoneal cells, lipid peroxidation, hematological studies, and solid tumor mass and in vitro cytotoxicity. Both the extract showed substantial antitumor activity at doses of 200 and 400mg/kg(21).

The methanolic leaves extract was evaluated for protective action against N-nitrosodiethylamine (DEN, 200mg/kg) induced experimental liver tumors in male Wistar rats. Administration of DEN has increased the levels of mitochondrial lipid peroxidation (LPO) and liver weight which were later found to be decreased by the administration of extract (200 and 400 mg/kg) in dose dependent manner. The extract also increased the levels of mitochondrial enzymatic antioxidants viz. Superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GPx) and non-enzymatic antioxidants like Reduced Glutathione (GSH) when compared to liver tumor bearing animals. The study suggested that MPC may extend its protective activity by modulating the levels of mitochondrial lipid peroxidation and liver weight and augmenting mitochondrial antioxidant defense system(22).

Antioxidant Activity: The successive leaves extracts were screened for antioxidant potential by using various in vitro assays. The results suggested that the plant leaves extracts which contain compounds that are capable of donating hydrogen to a free radical in order to remove odd electron which is responsible for radical's reactivity. Among six extracts, ethyl acetate and methanolic extracts showed maximum scavenging activity followed by chloroform and aqueous extracts

while petroleum ether showed minimum scavenging activity (23).

Anticonvulsant Activity: The methanolic extract of stem barks was studied for anticonvulsant activity against maximal electro shock (MES) and Pentylene-tetrazole (PTZ) induced convulsions in mice at doses of 200 and 400mg/kg i.p. using Phenytoin (25 mg/kg i.p.) as standard, the extract suppressed hind limb tonic extensions (HLTE) induced by MES and also exhibited protector effect in PTZ induced Seizures. Methanolic extract of stem barks showed significant anticonvulsant effect in both models(24).

Nootropic Activity: Methanol extract of stem bark at doses of 200, 400 and 600 mg/kg were administered once in a day for 7 days to rats and these rats were then subjected to Morris water-maze (MWM) test for spatial reference memory (SRM) and spatial working memory (SWM) models of memory testing. The inhibitory effect of the extract on acetyl cholinesterase (AChE) in discrete rat brain regions (prefrontal cortex [PFC], hippocampus [HIP] and amygdala [AMY]) was also investigated by using acetyl-thio choline iodide and di-thio-bis-nitrobenzoic acid reagent.

The oral administrations of methanol extract of *Prosopis spicigera* in all doses tested, significantly improved both spatial reference and working memories in the MWM test in terms of decrease in escape latency during SRM and increase in time spent in the target quadrant during SWM probe trial. A ceiling effect was observed at 400mg/kg. Pre-treatment for 7 days significantly inhibited the activity of AChE in the HIP, PFC and AMY(25).

Antidepressant and Skeletal Muscle Relaxant Activity: The aqueous leaves extract of *Prosopis spicigera* exhibited significant antidepressant like effect and skeletal muscle relaxant activity by using the forced swimming and tail suspension tests. It is used traditionally for the treatment of various CNS disorders. The antidepressant effect was evaluated using Forced Swim Test (FST). The antidepressant effect of leaf extract compared to that of imipramine (15mg/kg). The leaf extract at doses of 200mg/kg significantly decreased the duration of immobility time in FST. For Skeletal muscle relaxant action rota-rod test is used. The test used to evaluate the activity of drugs interfering with motor coordination(26).

Antihypercholesterolemic Activity: Hydro alcoholic 70% stem bark extract at a dose of 500 mg/kg was evaluated for antihypercholesterolemic activity in albino male New Zealand white rabbits using high fat diet induced hypercholesterolemia model using Atorvastatin (0.25mg/kg orally) as standard drug. The total cholesterol (TC), triglyceride (TG), LDL-Cholesterol, HDL-Cholesterol, atherogenic index,

ischemic indices and toxicity profile were estimated from serum samples at initial and final stages. The administration of bark extract significantly reduced serum total cholesterol (88%), LDL-C (95%), triglyceride (59%), VLDL-C (60%) and ischemic indices as compared to hypercholesterolemic control. The extract also significantly prevented the atherogenic changes in aorta(27,28).

Antihyperglycemic and Antihyperlipidemic

Activity: Hydro alcoholic extract of *Prosopis spicigera* at a dose of 750mg/kg, caused statistically highly significant decrease in the blood glucose levels of STZ induced diabetic rats as compared to the normal control. Chronic administration of the aqueous extract of *Prosopis spicigera* for 12 weeks in diabetic rats caused significant increase in the serum insulin levels, indicating that these fractions may probably activate the surviving β -cells of the islets of Langerhans and revert them to the normal state i.e. an insulinogenic effect. The decrease in body weight observed in the diabetic control group may be attributed to due to increase in muscle glucose uptake, which results in preventing tissue loss(29).

Antimicrobial and Antibacterial Activity: Ethyl ether and alcoholic leaves extracts were screened for antimicrobial activity by using three micro-organisms *Staphylococcus aureus* (Gram positive), *Escherichia coli* (Gramnegative) and *Candida albicans* (Fungal pathogen). The growth medium used for *Staphylococcus aureus* and *Escherichia coli* was Nutrient broth (10% peptone, 0.5% labanco and 0.5% NaCl, pH adjusted to 7.5) and for *Candida albicans* liquid medium (1% peptone, 4% glucose, pH adjusted to 5.8). Paper discs of known concentration of standard antibiotics namely chloramphenicol, penicillin and mycostatin were used for comparison. Both ethyl ether and alcoholic (50% ethanol) leaves extracts showed positive reactions against all the three test organisms(30). The methanolic and aqueous extracts of the stem bark of *Prosopis spicigera* exhibited moderate antibacterial activity with all the tested strains of microorganisms at 250 μ g/ml concentration on comparison with the standard ciprofloxacin. The obtained activity may be due to the presence of flavonoids and tannins(31).

Analgesic and Antipyretic Activities: Petroleum ether, ethyl acetate and ethanolic extracts of stem bark were evaluated for their analgesic and antipyretic activity by using different animal models. Ethanolic extract showed a significant analgesic activity in Eddy's hot plate model at a dose of 300mg/kg in experimental rats while petroleum ether extract exhibited a significant antipyretic activity using Brewer's yeast induced hyperpyrexia model at same dose(32). The ethanolic root extract at doses of 200 and

300mg/kg orally, evaluated for analgesic activity by using tail immersion and hot plate method and shows significant dose dependent activity. The aqueous leaves extract at a dose of 200mg/kg, evaluated for analgesic activity by using acetic acid induced writhing test in mice model and extract exhibited significant analgesic activity. The extract also exhibited a significant antipyretic activity at same dose using Brewer's yeast induced hyperpyrexia model.

Socio Economic Importance: *Prosopis spicigera* play major role in the socio economic development of the villagers due to its virtue of increasing soil fertility, providing fuel, timber and vegetables to human being. The pods of the *Prosopis*, used as dry fruit in extreme arid areas of the western Rajasthan. Pods also known as "Sangri". They are brown to chocolate in color and hang in the cluster of upto 12 from the tree. Dried pods, called as "Khokha" and used as Marwarimewa. They contain sucrose (13.16%), Protein (9-15%), and Carbohydrate (45-55%). If the growth of the phog (*Caligonum polygonides*) is increased, then the next crop yield is better means the phog directly affects the crop yields. When the growth of the pods is better it means there will be a good crop year. *Prosopis spicigera* provides green leaves (known as "Loom") to the animals like camel, goats and sheep's. Loom provides Nutritive Food stuff to the animals(33).

Conclusion

From the above review, it can be concluded that *Prosopis spicigera* is promising medicinal plant having wide ranges of pharmacological activities and used traditionally. However, after identification of various newer compounds from the plant, the researchers reported numbers of new activities and hence the plant is now achieving importance place to develop some more new search for the future development by understanding the gene level study. Therefore, considering its versatile medicinal uses, there is an ample scope for future research on *Prosopis spicigera* Linn.

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