

Ecology & Physiological Features of *Salvadora Persica* (Linn.) in Indian Arid Region

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ABSTRACT

S. persica is a multipurpose tree with immense ethno-ecological importance and is commonly used for varied medicinal purposes. It is one of the identified plants from among the seventeen plants families that are cited in the Holy Quran. The plant is used as a source of food, fodder, lipids, gum and resins. In addition, it is also valued for rearing honey bees. Its roots are regularly used as tooth brush throughout the country. Besides these the plant is also grown to provide shelter-belts and windbreaks for agriculture crops. It is distributed throughout the arid and semi-arid ecosystem of world and helps in reclamation of sand dune habitats and saline soils in arid ecosystems. However, its population suffers from serious environmental problems such as deforestation, soil degradation, loss of biodiversity and unsustainable livelihoods. *S. persica* has high medicinal, economic and ecological values in arid and semiarid ecosystem. Nevertheless, its conservation status is highly threatened and detailed ecological study of *S. persica* is suggested to conserve its remaining population. Miswak (*Salvadora Persica*) is an important shrub/small tree of the Indian sub-continent. Due to its multipurpose use it has been exploited ruthlessly by all the sections of the society since decades which has endangered its status. Because of its great medicinal properties it has been in heavy demand in the Indian Herbal Drug Industry. Its branches are commonly used as tooth brush in villages and rural area of the country. Apart from its medicinal benefits it can also be utilized for carbon storage and sequestration for long durations thus, helps in our fight against Global Warming and Climate Change. As the shrub/tree has become endangered all steps need to be taken to conserve this important species otherwise a time would come when we would be devoid of its multiple benefits. Plant Tissue Culture is an excellent technique for large scale propagation of this tree species and at present there are various protocols available in public domain for its mass multiplication but none of the protocols has been utilized to restore the plant status till date. Serious efforts by Government (Central and State) are required for mass multiplication of the species on one hand and conservation of its germplasm on the other.

How to cite this paper: Bharati Pareek
"Ecology & Physiological Features of
Salvadora Persica
(Linn.) in Indian
Arid Region"
Published in
International Journal
of Trend in
Scientific Research
and Development
(ijtsrd), ISSN: 2456-6470, Volume-6 |
Issue-3, April 2022, pp.1680-1684,
URL:
www.ijtsrd.com/papers/ijtsrd49820.pdf



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International Journal
of Trend in
Scientific Research
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KEYWORDS: Ecological, physiological, *Salvadora Persica*, Indian
Arid Region, large scale propagation

INTRODUCTION

Salvadora persica or the toothbrush tree is a small evergreen tree native to Indian arid region, the Middle East and Africa. Its sticks are traditionally used as a natural toothbrush called miswak and are mentioned by the World Health Organization for oral hygiene use. Other names include arak, jhak, pīlu, and

mustard tree. *Salvadora persica* is a small tree or shrub with a crooked trunk, typically 6–7 metres (20–23 ft) in height. Its Bark is scabrous and cracked, whitish with pendulous extremities. The root bark of the tree is similar in colour to sand, and the inner surfaces are an even lighter shade of brown. It has a

pleasant fragrance, of cress or mustard, as well as a warm and pungent taste. The leaves break with a fine crisp crackle when trodden on. The tree produces small red edible fruits, juicy but pungent, in clusters.[1,2]



It has high tolerance for salty soils and can tolerate as little as 200 millimetres (7.9 in) or less of mean annual rainfall, but it prefers ready access to groundwater. *Salvadora persica* stick, known as miswak, is popular for teeth cleaning throughout the Arabian Peninsula, Iranian Plateau, as well as the wider Muslim world. The fresh leaves can be eaten as part of a salad and are used in traditional medicine. The flowers are small and fragrant and are used as a stimulant and are mildly purgative. The berries are small and barely noticeable; they are eaten both fresh and dried. The wood of the *Salvadora persica* can be used for charcoal and firewood. In Namibia, the mustard bush is used as drought-resistant fodder for cattle. The seeds can be used to extract a detergent oil. As of 2009, Botanic Gardens Conservation International has a total of eight *Salvadora persica* plants in conservation.[3,4]



Shrub with berries

The miswak (miswaak, siwak, sewak, Arabic: سواك or مسواك) is a teeth cleaning twig made from the *Salvadora persica* tree (known as arāk, أراك, in Arabic). It is reputed to have been used over 7,000 years ago. The miswak's properties have been described thus: "Apart from their antibacterial activity which may help control the formation and activity of dental plaque, they can be used effectively as a natural toothbrush for teeth cleaning. Such sticks are effective, inexpensive, common, available, and contain many medical properties". It also features prominently in Islamic hygienical jurisprudence.[5,6]



Traditional miswak sticks. Softened bristles on either end can be used to clean the teeth.

Discussion

Salvadora persica is a large, well-branched evergreen shrub or small tree having soft whitish yellow wood, bark is of old stems rugose, branches are numerous, drooping, glabrous, terete, finely striate, shining, and almost white. Leaves are somewhat fleshy, glaucous, 3.8–6.3 by 2–3.2 cm in size, elliptic lanceolate or ovate, obtuse, and often mucronate at the apex, the base is usually acute, less commonly rounded, main nerves are in 5–6 pairs, and the petioles 1.3–2.2 cm long and glabrous. The flowers are greenish yellow in color, in axillary and terminal compound lax panicles 5–12.5 cm long, numerous in the upper axils, pedicels 1.5–3 mm long, bracts beneath the pedicels, ovate and very caducous. Calyx is 1.25 mm long, glabrous, cleft half-way down, lobes rounded. Corolla is very thin, 3 mm long, deeply cleft, persistent, lobes are 2.5 mm long, oblong, obtuse, and much reflexed. Stamens are shorter than corolla, but exserted, owing to the corolla lobes being reflexed. Drupe is 3 mm in diameter, globose, smooth and becomes red when ripe.[7,8]



***Salvadora persica* tree**

The leaves are eaten as a vegetable in the eastern tropical Africa and are used in the preparation of a sauce, and tender shoots and leaves are eaten as salad. Leaves are bitter in taste, corrective, deobstruent, astringent to the bowels, tonic to the liver, diuretic, analgesic, anthelmintic, useful in ozoena and other nose troubles, piles, scabies, leukoderma, lessening inflammation, and strengthening the teeth. Leaves are pungent and are considered in Punjab as an antidote to poison of all sorts and in south of Bombay as an external application in rheumatism. The juice of the leaves is also used in scurvy. Fruits are sweet and edible. A fermented drink is reported to be made from the fruits. Fruits possess deobstruent, carminative, diuretic, lithontriptic, and stomachic properties and are used in biliousness and rheumatism. In Sind, it is believed that fruits have a good effect on snake bite.[9,10]

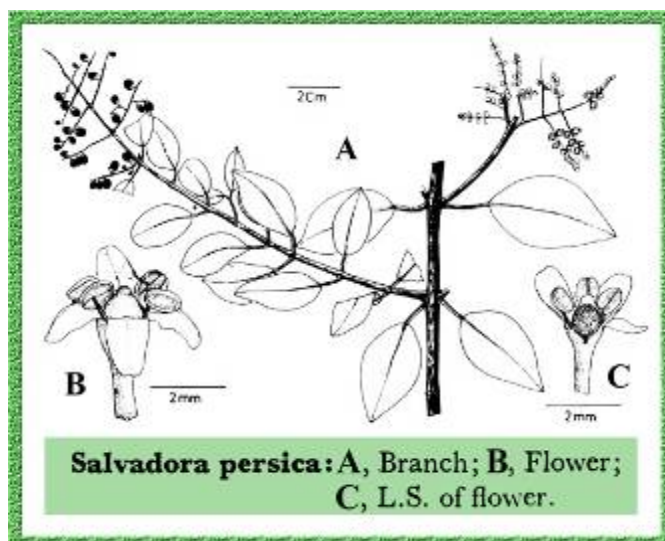
Root bark is used as a vesicant and is employed as an ingredient of snuff. A paste of the roots is applied as a substitute for mustard plaster and their decoction is used against gonorrhea and vesical catarrh. A decoction of the bark is used as a tonic in amenorrhea and the dose of the decoction is half a teacupful twice daily and as a stimulant in low fevers and as an emmenagogue.

On phytochemical investigations, its stem yielded octacosanol, 1-triactanol, β -sitosterol, and β -sitosterol-3-O- β -D-glucopyranoside. On thin layer chromatography examination, it was found to be a mixture of 2 compounds, which were separated by column chromatography. Compound A had a melting point (m.p.) $-136-7^{\circ}\text{C}$, $m/z = 414$ (mass) and molecular formula $\text{C}_{29}\text{H}_{50}\text{O}$ ($\text{C} = 83.75\%$, $\text{H} = 12.25\%$). It gave positive Salkowski, Liebermann, Burchard reaction, Noller reaction, Brieskron, Tschagajew, and yellow color with tetranitromethane. Peaks in the infrared spectrum at V_{max} KBr 3500, 1450, 1470, and 1145 cm^{-1} showed its identity as compound β -sitosterol in white needle form. Compound B was found to be the white crystalline

compound, with the molecular formula $\text{C}_{35}\text{H}_{60}\text{O}_6$, $\text{C} = 72.9\%$, $\text{H} = 14\%$, m.p. $265-68^{\circ}\text{C}$ $m/z [\alpha]_{\text{D}}^{29} -36.2$ gave positive test for saponin and on hydrolysis yielded β -sitosterol and a sugar glucose thereby identified it as β -sitosterol-3-O- β -D-glucopyranoside. Essential oil contained α - and β -thujones, camphor, cineole, β -cymene, limonene, β -myrcene, borneol, linalool, and bornyl acetate and nonvolatile fraction contained humulene, caryophyllene, β -santalol, and farnesol.[11]

Results

Salvadora persica possessed significant protective action against ethanol and stress-induced ulcers. This study was designed to confirm the antiulcer activity of *Salvadora persica* decoction using optical microscopy. The elements of gastric mucosa tended to be reestablished normally in tested rats. The effect of *Salvadora persica* as an anticonvulsant was identified by using stem extracts. The stem extracts show the potentiation of sodium pentobarbital activity and on generalized tonic-clonic seizure produced by pentylentetrazol (PTZ) on the rat is reported. The extracts of *Salvadora persica* Linn. extended sleeping-time and decreased induction-time induced by sodium pentobarbital, in addition it showed protection against PTZ-induced convulsion by increasing the latency period and diminishing the death rate. Miswak extract did not have much effect on female mouse fertility, although it caused a significant decrease in the relative weights of the ovary and an increase in the uterine weights. Exposure of male mice to miswak resulted in a 72% reduction in pregnancies in untreated females impregnated by test males. The relative weights of the testes and preputial glands were significantly increased and that of the seminal vesicles was significantly decreased in test males. The results indicate that miswak has adverse effects on male and female reproduction systems and fertility.[12,13]



Salvadora persica contain substances that possess plaque inhibiting and antibacterial properties against several types of cariogenic bacteria, which are frequently found in the oral cavity. The growth and acid production of these bacteria is thus inhibited. A comparison of alcohol and aqueous extract of miswak was also made. It was found that alcoholic extract is more effective than aqueous extract for antibacterial activity. In another study, miswak pieces were standardized by size and weight and tested against *Streptococcus mutans*, *Lactobacillus acidophilus*, *Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis*, and *Haemophilus influenzae*. Results found that the strong antibacterial effects against all bacteria tested is due to the presence of a volatile active antibacterial compounds. [14]

Part of plant	Activity reported
Stem	Beta-sitosterol elucidated
Stem	Hypolipidemic
Stem	Anti-ulcer
Stem	Anticonvulsant, sedative
Leaves	Antibacterial
Leaves	Antifertility
Stem & leaves	Hypoglycemic & hypolipidemic

Conclusion

Raising Propagules: Seeds are soaked for 24 hours in fruit pulp solution (*Salvadora persica*). They gave maximum germination and shoot growth. Two seeds are sown per polybag at 1.0-2.0 cm depth during June under nursery conditions. Thus 15 gm seeds are required for planting one hectare area at a spacing of 5 X 5 meter under field conditions

Land Preparation and Fertilizer Application: First ploughing of land is done in the first week of June, and left fallow for 20-25 days for solar exposure for drying weeds, aeration and facilitating decaying crop residues. Thereafter, a second ploughing is done and field leveled through planking. The crop is given NPK at 30:20:15 kg/ha plus hexameal treatment. Half of N and entire quantity of P and K are applied basally and the rest is given after 120 days. [15,16]

Transplanting and Optimum Spacing: Spacing of 5X5 meter is optimum for good growth under field conditions.

Inter culture and Maintenance Practices: Weeding and hoeing are carried out manually at 20 days after planting repeated after every 20 days in rainy season and after rains at 45 days intervals upto 3-4 years of age.

Irrigation Practices: Fortnightly irrigation schedule is more suitable for increasing the collar diameter, biomass, bark & root yields and Harvest Index, while

monthly irrigation is suitable for growth and height of the plant.

Weed Control: Manual hand weeding is a better option for weed control in *S. Persica* plantations.

Disease and Pest Control: No serious insects, pests and nematodes were observed in this crop.

Crop Maturity and Harvesting: Seeded fruits require 4-5 months for maturity, i.e. from December to April-May. The whole plant is used medicinally, but roots are used for preparation of Meswak toothpaste. The plant may be uprooted after 2 years of growth at any time of the year for root production. The roots are separated dried. [17,18]

Post-harvest Management: Uprooted whole plants are separated into leaf, stem and roots with the help of stainless knife/scalpels. Stem branches and roots are used freshly. If these are not used freshly, then these should be stored in well ventilated shady places, so that moisture loss takes place continuously.

Chemical Constituents: Root contains elemental γ-monoclinic sulphur, benzyl glucosimolate, a methoxylbenzyl derivative of urea named salvadorea, m-anisic acid and sitosterol. Root bark and stem bark contain trimethylamine. Seed oil is rich in myristic, lauric and palmitic acids. [19,20]

Yield : Plantation of crop at 5X5 meter spacing in one hectare area yielded 200 kg roots after two years. [21]

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