
Medicinally potent and highly salt tolerant plant of arid zone - *Salvadora persica* L. (Meswak): A Review

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Abstract: The Genus *Salvadora* is an oil yielding and medicinally potent genus belongs to the family Salvadoraceae. This genus consists of number of evergreen trees which occur in saline and non-saline habitats. *Salvadora persica* and *Salvadora oleoides* are two important species which are identified in India. *Salvadora persica* L. is reported to have more phyto-constituents and possesses numerous biological activities as compared to the other species. It is facultative halophytes found in dry and arid regions of India (Rajasthan, Haryana, Punjab, Maharashtra and Gujarat). Traditionally the wood sticks of *S. persica* have been used for cleaning the teeth and so named toothbrush tree which possess anti-bacterial, anti-diabetic, anti-fungal, anti-cancer, anti-ulcer, anti-plaque, anti-caries, anti-plasmodial activity. This review reveals the overall updates regarding its phytochemicals and pharmacognostical profile of this medicinally potent plant species.

Keywords: *Salvadora Persica*, Meswak, Toothbrush Tree, Oral Hygiene

1. Introduction

Medicinal plants of and semi-arid zones are good source of phytochemicals. However, supply of these plants are becoming difficult due to their limitation in conservation of the environment, technical and economical problems in cultivation and increasing labour costs (Jain 1996)[1]. Biotechnological applications in the genetic improvement of crops have a comparative advantage in the area of cost and environmental safety (Tewari 1979)[2]. The important and common plant species of arid and semi-arid regions belongs to *Salvadora*, *Zizyphus*, *Balanites*, *Calligonum*, *Acacia*, *Azadirachta*, *Prosopis*, *Euphorbia*, *Eucalyptus* and *Aegle*. These plants can survive in high range in temperature, slight frost and low rain-fall. Their roots penetrate deeply up to ground water level and so they do not compete for water with crop plants.

Among them *Salvadora persica* L. is a medicinal plant of great value. *Salvadora* belongs to family Salvadoraceae and is a small genus of evergreen tree or shrubs. In India, two species of the genus *Salvadora* occurs viz. *Salvadora oleoides* Decne and *Salvadora persica* L. (Bhansali and Jindal 1999)[3].

2. Distribution

The tree is widespread in desert areas of Africa and South Asia; confined to plains and low elevations up to about 900 m; occurs in dry water courses and rocky depressions. It occurs more widely in arid and semi-arid regions, including areas having black cotton soils. The tree has wonderful ability to grow in desert situations in sandy and barren lands, under low rainfall and dry weather conditions. It is distributed in India, Sri Lanka, Egypt, Israel, Pakistan, Sudan, Ethiopia, Senegal and Middle East countries near sea shore, along with rivers, where the ground water is near the surface. In India, it is found in arid and semi arid regions of Rajasthan, Gujarat, Punjab, Haryana, Karnataka, Andhra Pradesh, Tamil Nadu, Madhya Pradesh and in Uttar Pradesh (Gill et al., 1998)[4]. Amongst them, Rajasthan and Punjab are the main states where pilu is very common. These states are also the main collecting centre of pilu seeds with an estimated potential of above 47000 tonnes.

Salvadora persica commonly known as "Toothbrush tree"; Mustard tree" (English), Miswak, "Jhal", "Chhota "pilu", Kharjal (hindi), Piludi, Motijal' (Gujarat), "Kotumgo", "Toboto" (Orrissa) "Perungoli (Tamilnadu) "Khankan' (Mumbai) "Arak, "Kharjal' (Arab), Arak (French).

It has great medicinal value. Besides this, it holds several

other potentialities. The tree is suitable for growing in shelter belts and as wind breaks. It also provides seed fat and foliage for animals.

3. Taxonomy and Biology

The plant is a shrub or a small tree with a height of 15 to 30 feet, maturing in eight to twelve years. It has twisted trunk and drooping branches glabrous, terete, more or less glaucous branches, the two opposite branches arising symmetrically at an angle of 45° to the main axis.

The stem is often fissured bark is grey or whitish grey in colour. The leaves are opposite decussate, elliptic-lanceolate or ovate, obtuse and often mucronate at the apex, somewhat fleshy or coriaceous, Flowers are pedicellate, greenish-yellow in colour, and they are very small in size, arranged axillary or terminal compound panicles. Pedicels 1.5-3 mm long, bracts beneath the pedicels ovate, caduceous. calyx 3-4, Less than 1 mm corolla 4 and yellow, stamens 4 and smaller than corolla, ovary bilocular, disk absent, fruit is drupe, which is globose, smooth, red when ripe supported by the persistent calyx and corolla. Seed 1.4 mm in diameter globose erect smooth and brown. Seeding tree shoots fruiting after 7 to 9 years of planting whereas tree raised from root suckers bear fruits early in about 5 to 6 years. However, the start of the first bearing depends suckers bear early in about 5 to 6 years. However, the start of the first bearing depends on climatic and edaphic conditions, plant type and management practices. It can tolerate high temperature, low humidity as well as high rainfall. However, it is susceptible to frost. The tree thrives well on poor soils like sandy or sandy loam. Flowering period is long from January to April whereas fruits are available during April to June. The Fruits ripen in May and acquire a reddish brown colour (Yadav et al.2005; Saini et al 2006)[5,6]



Fig. 1. *Salvadora persica* plant

4. Disease and Pests

Extreme agro climatic conditions in arid zone not only generate greater biodiversity in plants but also provide congenial ground for perpetuation and manifestation of varied pests and diseases caused by different groups of pathogens. *Salvadora persica* L. is susceptible to many diseases and pests. Both seedlings and mature plants are

affected by viral diseases, especially crown gall (Iyengar et al, 1992)[7]. Fungi such as *Cercospora udaipurensis*, *Phytoplasma* spp., *Placosoma salvadorae* and *Septogloeum salvadorae* also damage the leaves of *S. persica* (Anon, 1972; Ershad, 1990)[8-9]. At the same time, *Thomasiina salvadorae*, induced gouty galls which were also noticed on the mid vein of *Salvadora persica*. Moreover, termite *amitemes belli* (Desneuse) eat heart wood and sapwood of *Salvadora* spp. However, no damage was seen on the bark. Besides, thrips and larvae of several beetles also known to attack this species and defoliate them (Iyengar et al, 1992)[6]. Similarly, *Catopsilia crocale* occurs on seedlings of *Salvadora persica* L. (Kumar and Ahmed, 1996)[10].

5. Variation

Local plant types have lot of variations, in yield, in taste and also in oil content. It is cross-pollinated species and show wide genetic variation in terms of tree morphology, high degree of variation in seed yield, seed oil contents and fruit colour. Much variations have also been observed in the oil content of seeds in individual tree species (Peshwae, 1987)[11].

6. Propagation

Natural regeneration occurs by seeds, layering and mostly by root suckers. It has good capacity for coppicing. Seeds are dispersed by birds, and often come up under other nurse shrubs such as *Capparis decidua* or *Tamarix* spp. The growth rate is rather slow during first two to three years of planting. Seedling trees get maturity after 7 to 9 years of planting. Whereas, tree raised from root suckers bear fruits early in about 5 to 6 years. Flowering period is long from November to March. The fruits are available during April to June. Plants are cared for watering and weeding especially in the first year of planting. Fresh seeds have a germination percentage of 65-70. However, some reports indicated the low rate of germination (30%). Moreover, Seeds can not be stored, as they are unable to retain viability. The plant is full of invaluable chemical properties possessing several metabolites of diverse potentials. At the same time, the seeds also have higher catalase activity. Because of this it is essential to soak them in lukewarm water for 9-12 hours. This also helps in separating the healthier seeds which are heavier from the rest. Salinity inhibits seed germination and the salinity of the water used for watering should not exceed 15.68 dsm. Watering and non-saline water, whenever available is beneficial for seed germination. The species is known to be viviparous. This problem can be overcome by the application of abscisic acid in in vitro conditions. Thus, tissue culture practices have played pivotal role in obtaining plantlets much faster than in vivo.

7. Climate and Soil Requirement

Salvadora persica L. is well adapted to a wide range of

edaphic and topographical conditions. It grows well in inland non-saline soil to highly saline along the sea coast. In the coastal areas it grows intertidal as well as above-tidal regions. It can tolerate high temperature, low humidity and also high rainfall. It has been found growing both the plains and in the hills up to an altitude of 900 m. It can tolerate temperature within a range of -3 to +48°C; mean annual rainfall 180-1000 mm, extreme drought and is hardy browse - tolerant, fire-resistant and wind-firm but rather frost - sensitive. The species is capable of withstanding frequent inundations by sea water (Iyengar et al., 1992)[7]. In highly saline areas it is bushier in habit with thick fleshy leaves. Seeds from *Salvadora persica* trees growing near the seashore are known to contain more oil than seeds from trees growing in non saline areas (Peshwae, 1987)[11]. At the same time, it gives more fruit if dry hot winds blow more frequently in summers.

Salvadora persica is more salt tolerant than *Salvadora oleoides*. It is a perennial halophyte which stores the excess salt in their leaves. However the excess sodium and chloride are eliminated through accumulation in senescent leaves (Rao and Babu, 1997; Maggio et al. 2000)[12-13]. The species is known to drastically restrict its water loss which considerably raises the temperature on the leaf surface.

It thrives on a variety of soil including sandy loam, clayey loam, gravelly, shallow, calcareous and sand dunes; tolerates a degree of salinity or alkalinity with pH of 6.5 to 8.5.

8. Economical Potentialities

8.1. Medicinal Value

Nature has created plants in world for every ailment, and there is a cure for every disease, man has to find it out. *Salvadora persica* L. has great medicinal potential. Almost all the parts of the tree used for curing human ailments, as well as fruits are fed to cattle to increase milk yield. The seed contains an oil which is called a "Kinknail oil".

The seed forms 44-46 per cent of the whole fruit. The seed contains fat (45-48%) albuminoids (18-94%) carbohydrates (23-48%), fibre (5-80%), and ash (3.50%). The seeds are also reported to contain quercetin, rutin and an alkaloid, probably dibenzylthio urea, dibenzyl urea, a thioglucoside, glucotropacolin which make the seed fat non-edible (Jindal et al 1996; Dogan et al 2005; Khalil and Taha 2006)[14-16]. Besides, seed also have nitrogen (4.8%) potash (2.8%) and phosphoric anhydride (1.05%) (Kamil et al 1999; Darmani et al 2003)[17-18].

The root bark contains resin and traces of alkaloids called "Salvadorine" trimethylamine and ash containing a large amount of chlorine (Malik et al 1987)[19]. Fruit contains a large amount of sugar fat and an alkaloid. Leaves contain salvadoricine, indole alkaloids, flavanoids etc. (Malik et al 1987; Ali et al 1997; Almas et al 2005; Siddiqui et al 2006; Ronse De Craene and Warntorp 2009)[19-23].

Table 1. Medicinal properties of plant parts of *Salvadora*

SNo.	Plant part	Medicinal Properties
1.	Root bark	It is used in dental diseases, particularly to reduce toothache. It is used as tonic and stimulant in low fever. Ali Qtaibi et al 2003[26]; Siddiqui et al 2006[22].
2.	Stem bark	It is used in gastric trouble and as an acaricide. The fresh bark is a vesicant and stimulant.
3.	Leaves	They are used to relieve cough and used as purgative. Their poultice is applied in piles and tumors, leaf juice is useful in scurvy and applied in rheumatism. Decoction of leaves used in asthma and cough. Malik et al 1997[19]; Ali et al 1997[20]
4.	Flowers	They yield an oil, which is stimulant and laxative, flower oil is used for curing worms, leprosy, gonorrhoea, headache and applied to painful rheumatic affections.
5.	Fruits	They are deobstruent carminative lithontriptic, diuretic and stomachic used in biliousness and rheumatism and are also given in enlargement of spleen.
6.	Seeds	Seeds are purgative, diuretic and tonic. They yield an oil which is applied on rheumatic swellings and all over the body after child birth.

(Almas 2001; 2002; 2005; Ali Qtaibi et al 2003; Alali et al 2004; Arora and Kaushik 2006; 2007; Sofrati et al 2008; Ronse De Craene and Warntorp 2009; Khatak et al 2010)[23-30].

8.2. Suitability in Agroforestry Systems

Pilu is found suitable to grow in alkali soils on which many species fail to grow. It also grows on farm boundaries as shelter belts for windbreaks in dry and arid areas. The plant can be tried with other tree species where arable crops cannot be grown. It is recommended for ravines, saline, alkaline blackish water areas and grasslands (Bhatia and Sharma, 2000)[31]. Thus, it helps in land reclamation (Zodape and Indusekhar, 1997)[32].

8.3. Seed Fat

Industrial use of natural fats and oils has a very long history. Only from the late 19th century they have been supplemented by petroleum products (Murphy, 1995)[33]. Almost 75% of the plant oils are derived from four major

crops; soybean, palm, rapeseed and sunflower. In majority of the plant oils, the C16 and C18 saturated and unsaturated fatty acids are predominant. This makes them more suitable as edible oil, and of only limited use for industrial purposes. There are many oil seed yielding species which exhibit enormous diversity in fatty acid composition, but are not cultivated now as crops. Many species producing oil seeds with high levels of individual fatty acids ranging in chain length from C8 to C24 are known. *Salvadora persica* L. is such an unconventional oil seed yielding species which grows in arid and saline soils. The seeds of *S. persica* yield a pale yellow solid fat. The seed forms 45-50% of the fruit and has about 35-40% oil content. The crude fat obtained by pressing the decorticated seeds in high pressure expellers or in ghanis is a dark coloured product having a bitter taste and a bad smell. The seed fat contains several acids (Table 2).

Table 2. Chemical components of seed cake

S. No.	Chemical Components	Percentage (%)
1.	Moisture content	12.40
2.	Crude protein	26.60
3.	Carbohydrates (reducing sugar)	22.00
4.	Total ash	16.90
Fatty acid composition		
1.	Lauric	19.6
2.	Myristic	54.5
3.	Palmatic	19.5
4.	Oleic	5.4
5.	Decoic	1.0
6.	Capric	1.0
Amino acid composition		
1.	Glycine	8.9
2.	Alanine	6.6
3.	Aspartic acid	8.5
4.	Glutamic acid	14
5.	Serine	8.3
6.	Threonine	6.0
7.	Valine	5.8
8.	Leucine	14.5
9.	Arginine	6.6
10.	Histidine	3.9
11.	Lysine	5.5
12.	Proline	5.6
13.	Tyrosine	3.8
14.	Cystein	2.4
15.	Methionine	5.8

Due to its high lauric and myristic acid content, the seed fat of *S. persica* can replace coconut oil and palm oil in soap and detergent industries. This will reduce the pressure on coconut oil for non-edible uses. Due to the undesirable colour and smell, it cannot be used directly for soap manufacturing. It is extracted with ethanol. The purified fat resembles coconut oil in its composition and can be used directly for soap making. Seed fat is also used in dyeing and in the preparation of suppositories.

8.4. Food

The fruits are sweet and edible. The pulp contains glucose, fructose and sucrose. Milch cattle when fed with pilu fruits increase milk yield. Leaves are also eaten as vegetables and used in the preparation of sauce. Tender shoots and leaves are eaten as salad.

8.5. Fodder

Although pilu does not produce quality fodder, however, foliage can be used as an emergency fodder for goats, camels and cattles. Seed fat also valued as cattle feed as it contains 27% crude protein and 22% carbohydrate.

8.6. Fermented Drink

Fruits are beneficial in preparation of fermented drinks.

8.7. Timber Wood

The wood is soft and white and takes good polish. It is used in manufacturing of agricultural implements, persian wheel boats, and is termite resistant. Egyptians used it for

coffins. composition and can be used directly for soap making. Seed fat is also used in dyeing and in the preparation of suppositories.

8.8. Fire Wood

A poor fuel wood with high ash content, but it can be well utilized along with other woods for brick burning.

8.9. Manure

Seed cake can be used as manure for tobacco crop.

8.10. Animal Feed

De-oiled seed cake could be used to feed live stock.

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