Salvadora persica

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ABSTRACT

Salvadora persica (kharijal) is a large, well-branched, and evergreen shrub or a tree resembling *Salvadora oleoides* (meethijal) found in the dry and arid regions of India. Chewing sticks have been used for centuries for tooth cleaning, and are recommended by the World Health Organization in areas where their use is customary. *Salvadora persica* has enormous reported activities. It has potential medicinal and research activities. *Salvadora persica* is a promising product and is useful to produce antiplaque, analgesic, anticonvulsant, antibacterial, antimycotic, cytotoxic, antifertility, deobstruent, carminative, diuretic, astringent, and also used in biliousness, and rheumatism. This review highlights the pharmacologic effects and therapeutic effects of *Salvadora persica*. The chemical constituents present in different parts of the plant are also discussed.

Key words: Antibacterial, hypolipidemic, miswak, *Salvadora persica*

INTRODUCTION

Salvadora persica Linn., commonly known as miswak (tooth brush), belongs to the family Salvadoracea. It is locally called as kharijal; BENG—Jhal; Mah—Khakhin Kickni, Miraj, Pelu, Pilva; GUJ—Kharijal, Piludi; TEL—Ghunia, Varagogu; TAM—Kalawa, kakkol, vivay; KAN—Goni-mara; and ORIYA—Kotungo, pilu.[1] It is widely distributed in the arid regions of India and often on saline soils. It is an upright evergreen small tree or shrub, seldom more than 1 ft in diameter reaching a maximum height of 3 m. The fresh leaves are eaten as salad and are used in traditional medicine for cough, asthma, scurvy, rheumatism, piles, and other diseases. The use of miswak is a pre-Islamic custom, which was adhered to by the ancient Arabs to get their teeth white and shiny.[2] The beneficial effects of miswak in respect of oral hygiene and dental health are partially due to its mechanical action and partially due to pharmacologic action. There is investigation of its different chemical constituents, which are responsible for these activities. Farooqi *et al.* isolated benzyl-isothiocyanate from *Salvadora persica* root, and they claimed to have found saponins along with tannins, silica, a small amount of resin, trimethylamine, and alkaloidal constituents. Ray *et al.* isolated β-sitosterol, m-anisic acid, and salvadourea. Lewis and Elvin-Lewis report a high content of minerals in the root, 27.06%[3-5] [Figure 1].

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BOTANICAL DESCRIPTION

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

Figure 1: *Salvadora persica* (chewing stick)

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. It is widely distributed in the drier parts of India, Baluchistan, and Ceylon and in the dry regions of West Asia and Egypt[6-8] [Figures 2–4].

Scientific classification

Kingdom	:	Plantae
Division	:	Magnoliphyta
Class	:	Magnoliopsida
Order	:	Brassicales
Family	:	Salvadoraceae
Genus	:	*Salvadora*
Species	:	*persica* *oleoides*
Binomial name	:	*Salvadora persica* (Khari Jaal) *Salvadora oleoides* (Meethi Jaal)

Figure 2: *Salvadora persica* tree

Figure 3: *Salvadora persica* fruits

Figure 4: *Salvadora persica* leaves

TRADITIONAL USES

Leaves

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

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.

Root bark

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.

Stem bark

Stem bark is used as an ascarifuge and also in gastric troubles.

Seeds

Seeds have bitter and sharp taste. They are used as purgative, diuretic and tonic seed oil is applied on the skin in rheumatism.[9,10]

CHEMICAL PROFILE OF *SALVADORA PERSICA*

On phytochemical investigations, its stem yielded octacosanol, 1-triacantanol, β-sitosterol, and β-sitosterol-3-O-β-D-glucopyranoside.[11] 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°C, m/z = 414 (mass) and molecular formula $C_{29}H_{50}O$ (C = 83.75%, H = 12.25%). It gave positive Salkowski,

Liebermann, Burchard reaction, Noller reaction, Brieskron, Tschagajew, and yellow color with tetranitro methane.[12-14] 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 [Figure 5]. Compound B was found to be the white crystalline compound, with the molecular formula $C_{35}H_{60}O_6$, C = 72.9%, H = 14%, m.p. 265-68°C m/z $[\alpha]_D^{29}$-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-glucopyransoside. 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-santatol, and farnesol.[15]

Benzylamide were also isolated. The isolated compounds were identified as butanediamide, N1, N4-bis(phenylmethyl)-2(S)-hydroxy-butanediamine (1), *N*-benzyl-benzamide (2), *N*-benzyl-2-phenylacetamide (3), and benzyl urea (4). Compound 3 revealed a significant inhibitory effect on human collagen–induced platelet aggregation, and a moderate antibacterial activity against *Escherichia coli*.[16]

Heavy metal contents are present in the leaf galls, which posses some growth promoting principles. Metal contents in the control as well as in the galls are prepared and presented in Table 1. The data show an enhanced content of Cu, Ni, Mn, V, Ti, and Mo in the galls when compared with the control. Metals are known to interact in biological systems and plant diseases are known to result from too much or too little of any one element or elements.[17,18]

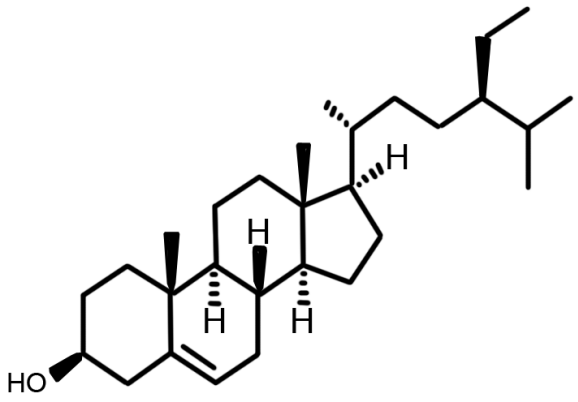

Figure 5: Structure of β-sitosterol

SEASONAL CHANGES IN PROTEINS AND AMINO ACIDS

It is reported that there are seasonal changes in the protein and amino acid concentrations in *Salvadora persica*. To find out these changes, 12 samples of soil (0–15) and plant material collected every month from 3 saline habitats of *Salvadora persica* near Bhavnagar were used for analysis. The results collected are represented in Tables 2 and 3.[19-21]

Table 1: Heavy metal contents in the control and galls in PPM

Metal	Control	Galls
Cu	6.0	8.0
Zn	5.0	5.0
Ni	8.0	10.0
Mn	20.0	25.0
Co	15.0	15.0
Pb	0.20	0.20
Cd	0.20	0.20
Ce	0.005	0.004
V	0.005	0.20
Ti	---	0.005
Mo	0.30	0.55
Hg	--	--
Fe	5.0	55.0

Table 2: Seasonal changes in proteins, amino acids in *salvadora persica*

	Leaves			Stems		
	Monsoon	Winter	Summer	Monsoon	Winter	Summer
Alanine	228±30	182±24	233±20	119±25	94±14	152±26
Arginine	73±34	133±46	137±68	61±23	128±40	93±31
Asparagin	193±56	179±45	293±94	341±78	278±98	368±106
Aspartic	304±57	511±165	422±84	626±99	360±75	451±86
Glutalic acid	89±15	105±25	97±21	57±16	63±14	64±10
Glutamina	89±15	105±25	97±21	57±16	63±14	64±10
Glycine	50±10	80±23	53±16	32±5	26±8	36±12
Isoleucine	68±14	59±18	86±31	51±10	19±5	61±21
Leucin	80±17	74±23	105±40	62±12	24±06	74±26
Prolin	32±8	22±5	37±7	26±6	19±3	22±7
Valin	76±12	61±21	45±16	185±26	38±10	40±11

Table 3: Seasonal variations of mineral ions (Meq g^{-1} d.wt.) In *Salvadora. persica*

	Leaves						
	Ash	Na+	K+	Ca^{+2}	Mg^{+2}	Cl-	Na/K
Monsoon	0.21±0.01	1.48±0.31	0.29±0.05	2.25±0.011	0.92±0.07	2.11±0.13	0.06±0.01
Winter	0.25±0.01	1.94±0.21	0.23±0.04	2.40±0.09	1.18±0.10	2.80±0.14	0.10±0.01
Summer	0.31±0.02	2.78±0.68	0.20±0.04	2.58±0.09	1.48±0.28	3.41±0.35	0.20±0.05
	Stems						
Monsoon	0.13±0.01	0.68±0.31	0.33±0.05	0.13±0.17	0.48±0.95	1.42±0.11	0.02
Winter	0.15±0.04	0.78±0.05	0.37±0.03	0.43 ±0.13	0.57±0.05	1.67±0.12	0.02
Summer	0.17±0.02	1.17±0.14	0.42±0.04	1.63±0.15	0.68±0.05	2.05±0.20	0.03

PHARMACOLOGIC ACTIVITIES

Hypolipidemic activity

The stems of *Salvadora persica* are widely used as tooth cleaning sticks in Arabic countries and decoctions show hypocholesterolemic properties. The effects of prolonged administration of a lyophilized stem decoction of *Salvadora persica* were evaluated in diet induced rat hypercholesterolemic. The preparation was administered for 15 and 30 days and cholesterol, HDL, LDL, and triglycerides plasma levels were assayed. The results showed that the *Salvadora persica* decoction significantly lowered cholesterol and LDL plasma levels in the rats, proving to be more active at 30 days of treatment. The systemic administration of Triton resulted in a rise in plasma cholesterol and triglyceride levels. The results showed that *Salvadora persica* decoction was inactive at 18 h after treatment, whereas at 27 h it was able to reduce cholesterol and LDL plasma levels; in all the experiments HDL and triglycerides were unchanged.[22]

Antiulcer activity

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.[23]

Anticonvulsant activity

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 pentylentertazol (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.[24]

Antifertility activity

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.[25]

Antibacterial activity

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.

The effects of the extracts of *Salvadora persica* and derum were examined on the proliferation of Balb/C 3T3 of fibroblast and viability of carcinogenic bacteria. For this, aqueous extracts of miswak and derum were prepared and their effects investigated on the growth of Balb/C 3T3 mouse fibroblast by measuring the mitochondrial dehydrogenase activity. Also the effect on the viability of various cariogenic bacteria was also determined. From the obtained results, it is concluded that miswak and derum have adverse effects on the growth of cariogenic microorganisms, with derum as more active than miswak; they show cell proliferation by 156% and 255%, respectively.[26]

Antimycotic activity

Aqueous extracts of miswak could be used to reduce the growth of *Candida albicans*. Such inhibition lasts for up to 36 h at concentrations of 15% and above.[27]

Release of calcium and chloride into saliva

Gazi *et al.* investigated the immediate and medium-term effect of miswak on the composition of mixed saliva. They reported that miswak produced significant increases in calcium (22-fold) and chloride (6-fold), and significant decreases in phosphate and pH, saturation of saliva with calcium inhibits demineralization and promotes demineralization of tooth enamel, whereas high

Table 4: Plant part and their reported uses

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

concentration of chloride inhibits calculus formation.[28,29]

Analgesic effect

Mansour *et al.* studied the analgesic effect of miswak decoction when injected into mice. They found that miswak was more effective against thermal stimuli than against chemical stimuli and also acts as an analgesic.[30-33]

Cytotoxicity

Mohammad *et al.* investigated the cytotoxic potential of *Salvadora persica* on gingival and other periodontal structures, using the agar overlay method. Results showed no cytotoxic effect by a freshly cut and freshly used miswak. However, the same plant used after 24 h does contain harmful components. Based on these findings they recommend cutting the used portion of the miswak after it has been used for one day and preparing a fresh part. The cytotoxicity in this study became evident only after 24 h because the agar overlay method depends on the diffusion of the medicament to the agar material.[34-37]

THERPEUTIC APPLICATIONS

Tooth paste

Some of the known commercial toothpastes produced from *Salvadora persica* plant are as follows: Sarkan toothpaste (UK), Quali-miswak toothpaste (Switzerland), Epident toothpaste (Egypt), Siwak-F toothpaste (Indonesia), Fluroswak miswak (Pakistan), Dentacare Miswak plus (Saudi Arabia).[38,39]

Mouthwashes

Miswak can be used as mouthwash as it reduces plaque. But no such preparation presently exists in the market.[40,41]

Endodontic irrigation solution

Although the antimicrobial activity of miswak has been reported, its toxicity must be considered. In addition, no report has been yet made on the utilization of the extract as an irrigant solution in endodontic practice. Samh *et al.* evaluated, in vitro, the effect of different concentrations of miswak extract on L929 cell line in tissue culture and compared the results with sodium hypochlorite (NaOCl). They found a concentration-dependent morphologic change of L929 cell line when exposed to miswak extract and NaOCl. They suspect recovery of the cells after a 4-h exposure period to different miswak extract concentrations.[42-44]

CONCLUSION

The knowledge of various medicinal plants being used is confined to mostly local healers, it is of utmost importance to record this knowledge for future generations, otherwise it will be lost forever with the death of local healers/ persons with knowledge about indigenous health care systems. The traditional values, faith, and indigenous knowledge related to indigenous health care systems of the present society are facing serious challenges due to migration of youths to cities and these urban migrants tend to determine their own cultural beliefs and practices. Thus, the recording of indigenous health care system becomes increasingly important for society. On the basis of a literature survey, it has been found that there are various traditional uses of miswak, which has to be scientifically proved [Table 4].

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