

The Active Chemical Constituent And Biological

Activity of *Salvadora persica* (Miswak)

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Abstract

The use of Miswak, chewing sticks (*salvadora persica*) can be traced back to Babylonians some 7000 years ago. It was later used throughout the Roman and Greek empires, and has also been used by ancient Egyptians and muslims. It is commonly used throughout the world specially for the purpose of oral hygiene. Muslims are using as the religious view. Current study deals with the study of miswak for their chemical composition and biological activity. It deals with the study of therapeutic uses of miswak. Finally, the study concludes that miswak should be use not only for the religious view but also for the benefit of its effects produced.

Keywords: Meswak, *Salvadora persica*.

Introduction

The traditional toothbrush or chewing stick is deeply rooted in Islamic culture. This article gives a brief cultural and historical background of the subject and review current literature on Miswak. Pencil-sized sticks of various plants are fashioned from certain plant - parts and are chewed on one end until they become frayed into a brush. The brush-end is used to clean the teeth in a manner similar to the use of toothbrush. When used in this manner, they are commonly referred to as chewing sticks or Miswak.¹

History of miswak : The miswak was practiced before the Islamic culture, after that used by the ancient Arabs to get their teeth white and shiny. It also contributed to ritual purity. This custom was adopted and Islamized by **Prophet Muhammad (PBUH)** Peace be upon him around 543 AD.

Morphological characteristics : *Salvadora persica* is an upright evergreen small tree or shrub, seldom more than one foot in diameter reaching maximum height of three meters. The leaves are small, oval, thick and succulent with a strong smell of cress or mustard.

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Table no.1 Type of Miswak

No.	Name	Biological source	Geographical source
01	Arak	Salvadora persica	Middle east
02	Lime tree	Citrus aurantifolia	West Africa
03	Orange tree	Citrus sinensis	West Africa
04	Senna root	Cassia vinnea	America
05	Neem	Azadirachta indica	Indian sub continent

Chemical composition :

Farooqi et al isolated benzyl-isothiocyanate from *Salvadora persica* root, they claimed to have found saponins along with tannins, silica, a small amount of resin, trimethylamine and a fairly large amount of alkaloidal constituents.¹

Ezmirly et al⁷ also found B-sitosterol, together with elemental sulfur (S8 a monoclinic form) in the root of *Salvadora persica*. They also found sulfur-containing mustard oil with the content of sulfur in the ash of the roots as high as 4.73%.¹

A study by Chawla reported that some types of chewing sticks such as Neem (*Azadirachta indica*), *Salvadora persica* and *Acacia arabica* contain a reasonable amount of fluoride.¹

Alcoholic Extraction of *Salvadora Persica* Chewing Sticks:

800g of *Salvadora Persica* chewing sticks were cut by using a knife and ground to a commercially available food blender. 120 ml of 60% ethanol was added to 40g of powder in a sterile well capped flask, left for 3 days at room temperature and then filtered using No.1 filter paper. The extract was incubated at 37°C until it became dry and stored in sterile screw capped vials in the refrigerator until needed.³

Pharmacological properties of miswak:

1. Antibacterial properties :

Studies have indicated that *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.

The miswak pieces were tested in two ways: embedded in the agar plate or suspended above the agar plate. Suspended miswak had comparable or stronger effects than miswak embedded in agar.

Miswak embedded in agar or suspended above the agar plate had strong antibacterial effects against all bacteria tested.

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.

Al Lafi and Ababneh tested the antibacterial activity of *Salvadora persica* against some oral aerobic and anaerobic bacteria and reported that the extract of these sticks had a drastic effect on the growth of *Staphylococcus aureus*, and a variable effect on other bacterial species. They commented that the chewing sticks they used were harvested one month earlier, and suggested that using more fresh sticks will give better result.⁴

2. Antimycotic activity:

Results of the investigation carried by Al- Bagieh et al suggest that aqueous extracts of Miswak could be used to reduce growth of *Candida albicans*. Such inhibition lasts for up to 36/h at concentrations of 15% and above.

According to this various concentration of aqueous extract of miswak prepared with sabouraud medium were incubated with *Candida albicans* (oral isolate) these were incubated at 37⁰C and turbidity was determined by OD at 600 nm wavelength measured at specific interval over a period of 48 hr data show that at concentration of 15% and above has fungistatic effect for 48 hr. This antimycotic effect was probably due to one or more of root content which includes chlorine ,trimethylamine , an alkaloid resin ,and sulphur compounds.⁵

3. Analgesic activity:

M.I.Sulaiman studied the analgesic activity of miswak decoction.

Results presented in this study showed that miswak decoction injected intraperitoneally into mice, lower their response to chemical and thermal stimuli in the three analgesic tests. Miswak was more effective against thermal stimuli than against chemical stimuli. It is generally accepted that response to thermal stimuli is mediated via skin pain receptors while response to chemical stimuli in writhing reflex test is mediated via visceral receptors. Therefore, it was assumed that miswak is more effective against peripheral pain than visceral pain. This may explain the traditional claim that miswak decoction relieves oral pain by its application to oral mucosa. The underlying mechanism for miswak analgesic action was unclear. However, as the effect of miswak was antagonized by naloxone, it was speculated that the effects could be mediated via interaction with the opiate system.⁶

4. Stimulation of Salivary secretion :

Sushil K. investigated the immediate and medium-term effect of Miswak on the composition of mixed saliva. Result of this study seemed to indicate that chewing of miswak increased the level of calcium and chloride significantly when both the group pooled together. In a study conducted by Gazi et al. in 1992 high amount of calcium and chloride were seen after chewing of miswak compare to corrugated rubber to stimulate salivary secretion.

Calcium saturation in saliva inhibits demineralization and promotes remineralisation of tooth enamel. High chloride content reduces calculus formation and activates amylase to limit caries formation.

These findings suggest that plant used as chewing stick may have the potential of releasing substance into saliva that could influence the state of oral health.⁷

5. Cytotoxicity:

Mohammad et al investigated the cytotoxic potential of *Salvadora persica* on gingiva 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 for after 24 hours 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 hours because the agar overlay method depends on the diffusion of the medicament through the agar material. In addition, it did not provide direct contact between the cells and the tested solution.⁸

6. Locomotor activity :

The effects of *Salvadora persica* extracts on mice exploratory locomotor activities and stereotype movements have been determined. Mice injected with *Salvadora persica* extracts showed significantly low exploratory locomotor activity. The exploratory locomotion of *Salvadora persica* treated mice declined than that of the controls. Mice injected with *Salvadora persica* extract also showed a significantly lower number of stereotype movements. (Mansour I, Journal of ethanopharmacology).⁹

7. Topical medicament :

Aqueous extract of miswak and propolis proved to have improving effect on post operative out come following lower third molar extraction. Both medicament used show ed good effect in reducing symptoms of pain especially at the third day and this is important in redusing the need for analgesic and antibiotic consumption. Other study suggested using the same medicament without the use of antibiotic and analgesic.¹⁰

8. Antiulcer activity :

The lyophilized decoction of *Salvadora persica* L. roots possesses a significant protective effect on ulceration induced by ethanol, indomethacin and cold restraint stress in rats. In this work, we study the effect of chronic intragastric administration of *S. persica* decoction on experimental acetylsalicylic acid (ASA)-induced ulcer in rats. The ulcer index significantly decreased after treatment with a lyophilized decoction of *S. persica* .The modification of gastric mucosa was observed by transmission electronic microscopy (TEM) confirming this result. In fact, in treated rats, the mucosa recovered to normal distribution. After *S. persica* treatment, some changes were detected in profiles of various cytoplasm organelles of parietal cells. Particularly, the intracellular canaliculi show an enlarged lumen with an increase in the number and length of microvilli. These morphological features of parietal cells after *S. persica* treatment suggest that the cells tend to recover a moderate secretory activity, even if the drug still discloses its inhibitory effect. Moreover, *S. persica* decoction possesses significant antiinflammatory activity.¹¹

9. Fertility :

This study involves the toxic effect of miswak on the reproductive system of the mouse. The result showed that exposure to miswak extract did not have much effect on female mouse fertility; although it causes a significant decrease in in the relative weight of ovary and increase in uterine weight. exposure to male mice resulted in 72% reduction in

pregnancy chances in untreated female impregnated by test male. The relative weight of the testes and perputial gland were significantly increased and that of seminal vesicles was significantly decreased in test males.

The result indicate that meswak has an adverse effect on male and female reproductive system and fertility.¹²

10. Antimicrobial activity :

The purpose of this study was to evaluate antimicrobial effect of extract of bark , pulp and entire *S.persica* in standardised condition. At 1,5,10, &50 % conc. which were tested against five different micro organism using blood agar ditch plate method. After 48 hr of incubation variable antimicrobial effect were produced At 10 & 50% concentration all extract were effective against *Streptococcus faecalis* .At 5% only bark and whole miswak extract were effective against *S.faecalis*.

Bark and whole plant were effective against *S.mutants* at 50 % concentration. *S.aureus*, *S.epidermidis* and *C.albicans* were not inhibited by any conc. of three extract.

S.persica has antimicrobial effect at higher concentration and there is difference between bark and pulp of miswak. The bark is effective against *S.faecalis* ,*S.mutant* at 5 ,10 ,50% concentration. and whole miswak is effective compared with bark and pulp separately.⁴

11. Hypolipidemic Activity

Salvadora persica was evaluated in diet-induced rat hypercholesterolemia. The preparation was administered for 15 and 30 days. Cholesterol, HDL, LDL and triglyceride plasma levels were assayed. The results showed that the *Salvadora persica* decoction significantly lowered Cholesterol and LDL plasma level in rats, providing to be more active at 30 days of treatment. The systemic administration of Triton results in a rise in plasma Cholesterol and triglyceride levels. The results obtained show that *Salvadora persica* decoction was inactive at 18 hr after treatment, whereas at 27 hr, it was able to reduce Cholesterol and LDL levels. In all experiments HDL and triglyceride were unchanged.²²

14. Anticonvulsant and sedative effect

The anticonvulsant and sedative effect of *Salvadora persica* L. stem extracts was studied. The effect of *Salvadora persica* L. stem extract on the potentiation of sodium pentobarbital activity and on generalized tonic-clonic seizure, produced by pentylenetetrazole (PTZ) on the rat is reported. The extract of *Salvadora persica* L. extended sleeping time and decreased induction time induced by sodium pentobarbital; in addition it showed protection against pentylenetetrazole induced convulsion by increasing the latency period and diminishing the death rate.²⁰

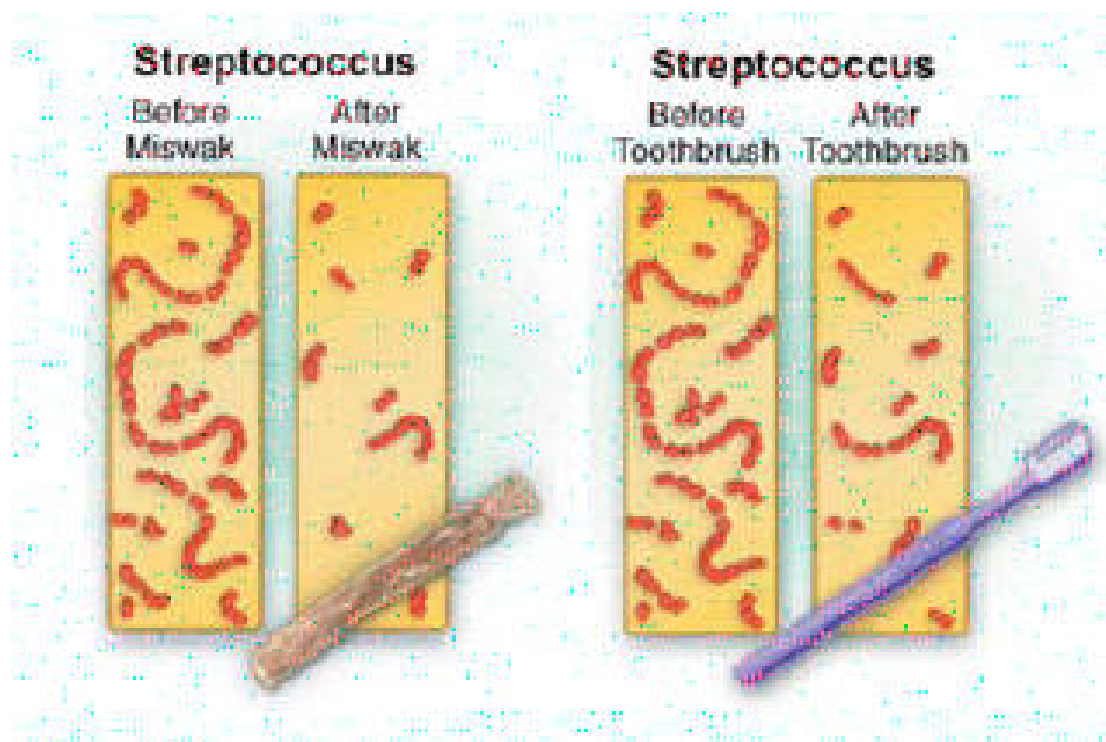


Fig.no.04 Antimicrobial Effect

15. Antiplasmodial Activity

Ethnobotanical investigations led to the selection of 19 plant species, used traditionally in Sudan against malaria and similar tropical diseases, for further studies. The antiplasmodial activity of the different extracts of *Salvadora persica* against *P. falciparum* NF54 strain were found to be 0.6 microg/ml (stems) and 0.7 microg/ml (leaves).²

Therapeutic application :

Some of known commercial tooth paste produced from *Salvadora persica* are :Sarkan tooth paste ,UK ,Quali – Meswak tooth paste ,Switzerland , Epident tooth paste ,Egypt

,Siwak F tooth paste ,Indonesia Fluoroswak ,Miswak Pakistan Dentacare Miswak Plus ,Saudi Arabia.¹

2. Oral hygiene :

Chewing sticks have been used for centuries as a tooth cleaning device. One of the most commonly used type is known as the miswak. Miswak is an oral hygiene aid and in widespread use even beyond the Arab world. The World Health Organization has recommended and encouraged the use of these sticks as a tool for oral hygiene in areas where their use is customary.¹⁴

3. Removal of smear layer :

The effects of aqueous extracts of chewing sticks (*Salvadora persica*) on the healthy and periodontally involved human dentine were evaluated with Scanning Electron Microscopy (SEM) *in vitro*.

25% aqueous extract of freshly prepared miswak solution was used for the study. Twelve human premolars teeth (6 healthy and 6 with periodontal disease) recently extracted for orthodontic and periodontal reasons were used. 24 SEM specimens were prepared and treated with miswak extract with different conditions e.g. soaking with miswak extract. Soaking the healthy and periodontally diseased root dentine in miswak extract resulted in partial removal of smear layer and occlusion of tubules was observed in dentine specimens burnished with miswak solution.

It was concluded that CHX 0.2% and miswak extract 50% had a similar effect on dentin in the control group. Miswak extract removed more smear layer as compared to CHX.²

4. Root canal irrigant :

The objectives of the current study were to evaluate the *in vitro* and *in vivo* antimicrobial effects of an alcoholic extract of *Salvadora Persica* solution as a root canal irrigant and to compare it with the currently used root canal irrigants (5.25% sodium hypochlorite, 0.2% chlorhexidine, and normal saline).

The results of *in vitro* antimicrobial effect of alcoholic extract of *Salvadora Persica*, sodium hypochlorite, chlorhexidine, and normal saline showed that all concentrations of

Salvadora Persica extract, sodium hypochlorite, and chlorhexidine had a significant antimicrobial effect against aerobic and anaerobic bacteria recovered from teeth with necrotic pulps, while normal saline had no significant antimicrobial effect. The best antimicrobial effect for Salvadora Persica extract was noticed at lowest concentration according to broth micro dilution method.

Results revealed that 15% alcoholic extract of Salvadora Persica had significant antimicrobial effect which was not significantly different from sodium hypochlorite and chlorhexidine, and significantly different from normal saline.⁴

5. Plaque control :

Few studies have reported on the cleaning effectiveness of chewing sticks. Cross-sectional studies show conflicting results. A cross-sectional study in Ghana among adults revealed higher plaque and gingival bleeding in chewing stick users as compared with toothbrush users. Another retrospective study showed that Miswak users had deeper pockets and more prevalence of periodontal diseases.

In contrast, no differences in plaque and gingival bleeding were found between toothbrush and chewing stick users among 7-15 years old children in Tanzania. It is reported that patients using Miswak regularly show decreased gingival bleeding on probing compared with non-Miswak users. Thus, poor oral hygiene with those using chewing sticks may be a reflection of poor techniques.

On the other hand, controlled longitudinal studies were more consistent. A clinical trial study on Ethiopian school children comparing mefaka (Miswak) with conventional toothbrush, found Miswak to be as effective as the toothbrush in removing oral deposits. The study also found instruction and supervision to be important since the children in the sample were found not to be familiar with Miswak techniques.

The study further concluded that Miswak should be used in preventive dental programs, as it was economical and familiar to the older people. In a clinical trial among adolescents in Nigeria, the results showed that the *Massularia acuminata* chewing stick was as effective in controlling and removing dental plaque as the toothbrush and paste.¹

6. Dental gel :

The present paper includes in vitro evaluation of antimicrobial activity of Miswak stems against different microorganisms including dental pathogens and formulation of bioactive extract into suitable dental gel.

Air-dried powdered stems were extracted with various solvents and each extract was evaluated for antimicrobial activity against test organisms including dental pathogens by agar diffusion technique. Dichloromethane extract showed significant antimicrobial activity, which was comparable with standards Chloramphenicol and Clotrimazole. This bioactive extract was formulated into dental gel using suitable gelling agent. The gel was evaluated for various physicochemical parameters, spreadability, mucoadhesion, dissolution, in vitro permeation, and antimicrobial activity.

Dichloromethane extract of Miswak stems possesses good antimicrobial activity, confirming the traditional claim. A dental gel containing this extract was successively formulated with enhanced penetration and greater activity. This mucoadhesive dental gel has significant potential for treatment of periodontal diseases.¹⁵

8. Gingival recession :

A relatively high prevalence of gingival recession among adults in Tanzania has been reported. Gingival recession on buccal surfaces has been ascribed to brushing habits. Since the lingual surfaces in the Tanzanian population exhibits gingival recession to the same extent as the buccal surfaces, as has been reported, then it is doubtful that the Miswak is the cause of high prevalence of gingival recession.

Younes and El-Angbawi reported that about 22% of the Saudi school children with gingival recession used Miswak. The low percentage of calculus deposits found in the group affected by gingival recession may be due to the common use of Miswak.

It has been reported that Miswak users had significantly more sites of gingival recession than did the toothbrush users. Further more, the severity of the recession was significantly more pronounced in the Miswak users than that in the toothbrush users. However, the gingival recession reported in Miswak users may be a reflection of poor techniques.¹

Miscellaneous application of miswak :

1. Effect on soil salanization :

Effects of salinization of soil on emergence, seedling growth and mineral accumulation of *Salvadora persica* Linn. (Salvadoraceae) were studied. Results suggested that this tree species is salt tolerant at seed germination and seedling stages. Elongation of stem and root was retarded by increasing salt stress. Young roots and stem were most tolerant to salt stress and were followed by leaves and old roots. Leaf tissue exhibited maximum reduction in dry mass production in response to increasing salt stress. However, production of young roots and death of old roots were found to be continuous and plants apparently use this process as an avoidance mechanism to remove excess ions and delay onset of ion accumulation in this tissue.

This phenomenon, designated “fine root turnover” is of an importance to the mechanisms of salt tolerance. Plants accumulated Na in roots and were able to regulate transfer of Na ions to leaves. Stem tissues were barrier for translocation of Na from root to leaf. Moreover, K significantly increased in leaf, but decreased in root tissues with increased salinization. Nitrogen content significantly decreased in all tissues (leaf, stem and root) in response to low water treatment and salinization of soil. Phosphorus content significantly decreased, while Ca increased in leaf as soil salinity increased. Changes in elements accumulation pattern and the possible mechanisms for avoidance of Na toxicity in tissues and organism level are discussed.¹⁷

2. Industrial oil production :

Salvadora Persica appears to be potentially valuable oil seed crop for saline and alkali soil, since the seed contain 40-45% of oil rich in indystrially important lauric acid (c12) and myristic acid (c14) acids. Attempts were made to asses the performance of the specis on the saline and alkali soil.

From the result it was evident that the species can be grpwn on both soil type. however height, spread and seed yield were significantly higher for plants grown on saline soil compare to alkali soil .No saignificant difference was observed in oil content from both type of soil.

The study indicate that *S.persica* can be cultivated as a source of industrial oil on both saline and alkaline soil for economic and ecological benefit.¹⁹

Conclusion :

Extensive literature survey revealed that *Salvadora persica L.* is an important medicinal plant with diverse pharmacological spectrum. Much of the traditional uses have been validated by scientific research. A number of chemicals isolated from plants like the chloride content helps to remove stain from the teeth; the silica helps to whiten them; the resin may form a coating over the enamel; trimethylamine has a stimulating effect on the gums; vitamin-c contributes to the healing and repair of the tissues; and the presence of sulfur compounds and alkaloidal content led antibacterial activity to the product. The plant has been extensively studied in terms of pharmacological activity of its major components, and the results indicate potent antimicrobial, anticonvulsant, analgesic, ace-inhibiting, antimycotic, hypolipidemic, antiplasmodial, antibacterial, antiulcer, topical medicament, locomotor activities.

In recent years, emphasis of research has been on utilizing traditional medicines that have a long and proven history of treating various ailments. In this regard, further evaluation needs to be carried out on *Salvadora persica* in order to explore the concealed areas and their practical clinical applications, which can be used for the welfare of the mankind.

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