

## REVIEW ARTICLE

# Effects of *Salvadora Persica* on Oral Health: A Bird's Eye View

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## ABSTRACT

A healthy mouth leads to a healthy body. Good oral hygiene is the key to a good oral and systemic health. A toothbrush and toothpastes are commonly used in developed and developing countries for cleaning teeth. Miswak has its unique role in oral hygiene and maintenance of oral health. This review discusses the history and chemical composition of *Salvadora persica* (miswak) and its influence on oral health, including the advantages, and disadvantages of its use.

**Keywords:** History, Miswak, Oral health, Pharmacological effects.

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## INTRODUCTION

The evolution of the modern toothbrush may be traced to chewing sticks that were used by Babylonians as early as 3500 BC, and to toothpicks that were chewed onto help clean the teeth and mouth and were described in ancient Greek and Roman literatures.<sup>1</sup> Chewing sticks are prepared from a variety of plant species and are customarily used for cleaning teeth in Asia, Africa, South America, and the Middle East.<sup>2</sup> Western travelers and explorers described the use of chewing sticks by men and women in the Sahara region and Sudan.<sup>3</sup> Chewing sticks are known by different names in different cultures: "Arak" or "miswak" in Arabic, "koyoji" in Japanese, "qesam"

in Hebrew, "qisa" in Aramaic, and "mastic" in Latin. The availability, low-cost, simplicity, and religious and/or traditional associations of chewing sticks have made them popular through modern times. Chewing sticks may play a role in the promotion of oral hygiene, and further evaluation of their effectiveness is warranted, as stated in the 2000 World Health Organization (WHO) Consensus Report on Oral Hygiene.<sup>4</sup>

*Salvadora persica* (Salvadoraceae) tree derives its Persian name, darakht-e-miswak or tooth brush tree, from the fact that wood is much employed for the manufacturers of tooth brush. It is a large much-branched, evergreen shrub or a tree, found in the dry and arid regions of India, and on saline lands and in coastal regions just above the high water mark. Bark is dull grey or grey-white, deeply cracked, and leaves are variable in shape – elliptic-ovate or ovate-lanceolate – somewhat fleshy. Flowers are pedicellate, greenish-white or greenish-yellow in lax panicles, drupes are globose or round, smooth, red when ripe. The trees readily regenerate from seeds and coppice well. Leaves are eaten as a vegetable in eastern tropical Africa and are used in the preparation of a sauce, and tender shoots and leaves are eaten as salad. Fruits are sweet and edible. A fermented drink is reported to be made from the leaves.<sup>5</sup>

## WHAT IS 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 a toothbrush. When used in this manner, they are commonly referred to as chewing sticks or miswak. The conventional meaning of Miswak is "stick used on teeth and gums to clean them." Its various names are Miswak and Siwak as used in the Middle East, Miswaki in Tanzania, Mefaka in Ethiopia, and Datun in India and Pakistan. Although, Siwak or Miswak is used to describe Arak (*S. persica*), the stick which the Prophet Muhammad – Peace and Blessings of Allah be upon Him (PBUH) – used to clean his mouth with, miswak is a more general term which includes all types of sticks used as tooth-cleaning aids.

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## DIFFERENT TYPES OF MISWAK

In the Middle East, the most common source of chewing sticks is Arak (*S. persica*). In West Africa, the lime tree (*Citrus aurantifolia*) and the orange tree (*Citrus sinensis*) are used. The roots of senna (*Cassia vinnea*) were used by Black Americans, and those of African laburnum (*Cassia sieberiana*) were used in Sierra Leone. Neem (*Azadirachta indica*) is widely used in the Indian subcontinent. Arak, a tree used for miswak, is also known as “tooth brush tree” and “mustard plant”. Although the miswak is usually obtained from the roots of the Arak tree, some sticks are made from its branches and bark.<sup>6,7</sup>

## RELIGIOUS BACKGROUND OF MISWAK

Islam introduced basic oral hygiene by incorporating it as a religious practice. Islam teaches the importance of cleanliness of the body as well as of the mind. Several quotations are found in the compendium of the Prophet Muhammad (PBUH), as to the benefits of miswak in oral hygiene. For example, Prophet Muhammad (PBUH), said: “Siwak purifies the mouth and pleases Allah” and said: “Were it not to be a hardship on my community, I would have ordered them to use Siwak for every ablution”.

## HISTORICAL AND CULTURAL BACKGROUND OF MISWAK

The chewing stick was used by the Egyptians, the Jews, and the Muslim world. References to the use of chewing stick can be found in the Talmud, as the Quesum, the Siwak, Miswak, and Arak. Its use as a chewing stick or Siwak was documented in the Arabian Muwasha written by Alwashah, in 900 AD. It is believed that the modern day tooth brush was not known in Europe until about 300 years ago. Medical texts of ancient India, Susruta Samhita and Charaka Samhita, have also emphasized on oral hygiene and brushing teeth with herbal sticks. Chewing sticks have various other uses, such as – using them as jaw exercisers, inducing a reflex of copious saliva secretion, combating undesirable oral habits including smoking and thumb-sucking, and lastly, they can also be used during the teething process. In terms of geographical distribution, its usage is widely spread and ranges from countries, such as Malaysia, Nepal and India in the East through Iran, Iraq, Pakistan, Saudi Arabia, and Egypt to Mauritania in the West, from North Africa and Central Africa to Southwestern Africa. In the Middle East, Arak (*S. persica*) is the most common chewing stick. Not only are miswak used for oral hygiene, they are also related to religious rituals and social purposes. One hundred and eighty-two kinds of plants/shrubs have been used as chewing sticks, throughout the developing

world; the most significant is Arak, *S. persica*. The roots, twigs, and stems are the specific parts of the plant that provide dental hygiene.<sup>8-10</sup>

## CHEMICAL COMPOSITION OF MISWAK

Farooqi et al isolated benzylisothiocyanate (BIT) from *S. 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. Ray et al found B-sitosterol, m-anisic acid, and salvadourea [1,3-bis-(3-methoxy-benzyl)-urea]. Lewis and Elvin-lewis report a high content of minerals in the root: 27.06%. Ezmirly et al also found B-sitosterol, together with elemental sulfur (S8 a monoclinic form) in the root of *S. persica*. They also found sulfur-containing mustard oil with the content of sulfur in the ash of the roots as high as 4.73%. Attar indicates that plant fibers contain sodium bicarbonate. El-Mostehy et al reported finding the following chemical substances: Trimethylamine, an alkaloid, chlorides, high amounts of fluoride, silica (SiO<sub>2</sub>), sulfur, vitamin C, and small amounts of tannins, saponins, flavenoids and sterols. Akhtar and Ajmal mentioned resin and large amounts of salts containing chlorine. A study by Chawla reported that some types of chewing sticks, such as Neem (*A. indica*), *S. persica* and *Acaccia arabica* contain a reasonable amount of fluoride.<sup>11-18</sup>

Silica in miswak acts as an abrasive material to remove stains giving the teeth whiteness. Tannins (tannic acid) are a mixture of esters of gallic acid with glucose whose exact composition varies according to its source. Tannic acid is an astringent that precipitates albumin. Its topical use is now restricted to the treatment of bedsores, minor ulcerations, and the likes. Tannic acid shows antitumor effect on animals and *in vitro*. It exerts an astringent effect on the mucous membrane, thus reducing the clinically detectable gingivitis. Tannins also inhibit the action of glucosyltransferase thus reducing plaque and gingivitis.

Resins are amorphous products with a complex chemical composition. They are end products of metabolism. Physically, they are usually hard, transparent, or translucent and, when heated, soften, and finally melt. Chemically, they are complex mixtures of resin acids, resin alcohols (resinols), resin phenols (resinotannols), esters, and chemically inert compounds. Resin forms a layer over the enamel and thus protects against caries. Alkaloids are one of a large group of basic nitrogenous organic compounds found in plants, usually having strong physiological or toxic effects on the animal body. They are usually derivatives of nitrogen ring compounds, presenting colorless crystals that are bitter in taste, soluble in alcohol, and slightly soluble in water, their names end in –ines. Examples are atropine, caffeine, coniine, morphine, nicotine, quinine, and strychnine.

The term is also applied to synthetic substances, such as procaine. The alkaloid present in *S. persica* is Salvadorine, which yields trimethylamine on hydrolytical cleavage. It exerts a bacteriocidal effect and stimulatory action on the gingiva. Essential (volatile) oils possess characteristic aroma and exert carminative, antiseptic action. The mild bitter taste stimulates the flow of saliva, which is antiseptic. The sulfur compounds present in miswak as shown by their pungent taste and smell have a bactericidal effect. Vitamin C helps in the healing and repair of tissues. Sodium bicarbonate (baking soda)  $\text{NaHCO}_3$  has mild abrasive properties and is, thus, used as a dentifrice, in addition to a mild germicidal action. High concentrations of chloride inhibit calculus formation and help in removing stains from the teeth. Calcium saturation of saliva inhibits demineralization and promotes remineralization of tooth enamel. The root of *S. persica* contains a steam-distillable oil composed of 10% benzylnitrate and 90% BIT. Benzylisothiocyanate is classified as one of the chemopreventive agents that are thought to prevent carcinogenic and other genotoxic compounds from reaching or reacting with the target sites on the treated tissue.<sup>19-28</sup>

### WHEN TO USE MISWAK

Miswak should be used before meals to remove the bacteria that convert sugar into acid, or immediately after meals. However, the latter is impractical, since the fall in pH and the associated damage occur within a few minutes, and 20 minutes later the saliva performs the buffering action itself. It does not seem that the use of miswak occurs regularly after meals. In general, it is recommended to use miswak five times a day. A common fault is the habit of keeping it in the mouth while domestic duties are carried on, with the complete neglect of the stick. A definite time should be set aside for the use of the chewing stick; five minutes of complete devotion to this function is deemed sufficient to ensure good cleansing. The resulting smooth feel of the teeth with the tongue gives a critical measure of the efficiency and effectiveness of the chewing stick.<sup>7</sup>

### HOW TO PREPARE MISWAK?

Miswak is available in various diameters and lengths and can be further cut into suitable lengths by the user. A length of 20 cm for adults and 15 cm for children is recommended for convenience of grip and ease of manipulation in a confined space. An excessively long stick may result in serious traumatic injuries, from the intraoral end. This is possible because most people habitually carry out their oral hygiene whilst continuing with other domestic duties. The diameter is normally one centimeter. This gives a supple stick which is firm enough to transmit the

pressure of the cleansing action to the teeth without breaking off. The thicker sticks tend to be older and difficult to chew. Miswak should be freshly cut so that it is supple, easily chewed, and still rich in active constituents. The root should be whitish-brown in color; a dark brown color indicates that the miswak is no longer fresh. A very dry miswak can be expected to damage the gums and other oral tissues. If a stick is dry, the end for chewing should initially be soaked in fresh water for 24 hours. It should be noted that soaking for unduly long periods causes loss of active constituents and diminishes the therapeutic properties, although the mechanical effects on the teeth can still be expected to occur. Before miswak is used, the end should be washed with water. It is then chewed repeatedly until the fibers stand out like the bristles of a toothbrush. These fibers should be clipped of every 24 hours. If possible the miswak should be kept in a moist place when not in use.<sup>7</sup>

### HOW TO USE MISWAK?

Miswak is very similar to the toothbrush in that both have bristles and are used to remove plaque from the tooth surfaces mechanically. However, miswak may also have a chemical action and may be chewed or sucked for several hours daily by some people. But unlike a conventional toothbrush, the bristles of the miswak lie in the same long axis as its handle. The angulation in the toothbrush enables it to adapt more easily to the distal tooth surfaces particularly on the posterior teeth. The techniques employed for removing plaque mechanically are similar with the toothbrush and the chewing stick, e.g., vertical and horizontal brushing.

There are two basic holds, Pen-grip (three-finger grip) or palm-grip (five-finger grip). In each case the aim is to ensure:

- Firm but controlled movement of the brush end of the miswak within the oral cavity.
- That every area of the mouth is reached with relative ease and convenience.<sup>7</sup>

The cleaning movement should always be directed away from the gingival margin of the teeth on both the buccal and lingual surfaces. An anterior-to-posterior scrubbing movement is used on the occlusal surfaces. Care should be taken to avoid damaging the soft tissues of the mouth. Satisfactory cleaning can be achieved if this procedure is followed for five minutes. The tongue is commonly cleaned by users of chewing sticks, the objective being to control bad breath and remove the white coating that develops on the dorsum of the tongue. This surface is usually cleaned by means of the brush end of the chewing stick, but better results are obtained by breaking the stick into a V-shape and scraping the resulting blade several times across the tongue.<sup>30</sup>



## PHARMACOLOGICAL PROPERTIES

- **Antibacterial properties:** *S. 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 are thus inhibited. Al Lafi and Ababneh tested the antibacterial activity of *S. 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 1 month earlier, and suggested that using more fresh sticks will give better results.
- **Antifungal effect:** Al-Bagieh et al<sup>31</sup> concluded that aqueous extracts of miswak could be used to reduce growth of *Candida albicans*. Such inhibition lasts for up to 36 hours at concentrations of 15% and higher. A recent study by Almas et al reported that *S. persica* extract did not affect the viability of *C. albicans*. Al-Bayati and Sulaiman (compared the aqueous and methanol extracts of *S. persica* chewing stick for antimicrobial activities against seven isolated oral pathogens (*S. aureus*, *Strept mutans*, *Strept pyogenes*, *Enterococcus faecalis*, *Lactobacillus acidophilus*, *Pseudomonas aeruginosa*, and *C. albicans*) using two different methods. Both antimicrobial assays resulted that the aqueous extract inhibited all isolate microorganisms and was more efficient than the methanol extract, which was resisted by *L. acidophilus* and *P. aeruginosa*. The most pronounced and strongest antibacterial activity was shown by the aqueous extract against *E. faecalis*. Turbidity tests exhibited that both extracts had equal antifungal activity against *C. albicans*. Further research is needed in antimycotic/antifungal effects of miswak.<sup>32,33</sup>
- **Release of calcium and chloride into saliva:** Gazi et al<sup>19</sup> 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. Calcium saturation of saliva inhibits demineralization and promotes remineralization of tooth enamel, whereas high concentrations of chloride inhibit calculus formation.
- **Analgesic effect:** 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 the response to chemical stimuli in writhing reflex test is mediated via visceral receptors. Therefore, it was assumed that miswak is a 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.<sup>34</sup>
- **Anticonvulsant and sedative effect:** The anticonvulsant and sedative effect of *S. persica* L. stem extracts were studied. The effect of *S. 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 *S. persica* L. 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.<sup>35</sup>
- **Effect on oral microorganisms:** Miswak also acts as antibacterial agent. Sofrata et al<sup>36</sup> while studying the effect of miswak pieces on bacteria in periodontitis and dental caries concluded that the antibacterial effect was most pronounced on *Porphyromonas gingivalis*, *Actinobacillus actinomycetemcomitans*, and *Haemophilus influenzae*, less on *S. mutans*, and least on *L. acidophilus*. They also reported that the antibacterial effect of miswak suggests the presence of volatile active antibacterial compounds.
- **Role in plaque reduction:** Sote<sup>37</sup> found that regular users of miswak show decreased gingival bleeding on probing compared with non-miswak users. A study on Ethiopian school children comparing miswak with conventional toothbrush found that miswak is as effective as the toothbrush in removing oral deposits. Ray et al<sup>12</sup> found 75% plaque reduction after 8 days of miswak use. Rinsing with a slurry of miswak toothpaste reduces gingival inflammation and bleeding on probing. Gazi et al reported that plaque and gingivitis were significantly reduced when miswak was used 5 times a day compared with a conventional toothbrush.
- **Endodontic irrigation solution:** 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-hour exposure period to different miswak extract concentration.<sup>38</sup>

- **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 a 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.<sup>39</sup>
  - **Toothpaste, mouthwashes:** Miswak is used in commercial preparation of a number of toothpaste *S. persica* plant are as follows: Sarkan toothpaste (UK), QualiMeswak toothpaste (Switzerland), Epident toothpaste (Egypt), Siwak-F toothpaste (Indonesia), Fluoroswak, Miswak (Pakistan), and Dentacare Miswak Plus (Saudi Arabia). Mustafa et al reported a reduction in plaque formation by miswak based mouthwash.<sup>40</sup>
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## COMMERCIALY AVAILABLE PREPARATION

- Mint fresh herbal toothpaste
- Himalaya herbal active fresh gel
- Himalaya herbal sensitive relief toothpaste
- Himalaya herbal sparkling white toothpaste
- Himalaya herbal dental cream
- Complete care herbal toothpaste
- Hiora mouthwash regular.

## CONCLUSION

Miswak (*S. persica*) reduces the microbial count in different groups and improves the oral health. The extract possesses antibacterial and antiplaque property and it can be used effectively as a natural tool for teeth cleansing and as a natural analgesic for the disturbing toothache. The drug is also reported to possess anti-inflammatory, anticonvulsant, sedative actions. However, further research should be conducted to explore probiotic and antioxidant role of miswak.

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