

The Effectiveness of *Salvadora persica* (miswak) on Periodontal Health, Literature Review

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ABSTRACT

Periodontal disease is a global prevalent burden on well-being and health-related quality of life. Adequate plaque control on a daily routine basis is the most critical thing to achieve periodontal health. Using toothbrushes in combination with dentifrices is one of the most common methods of oral hygiene maintenance. However, natural chewing sticks such as *Salvadora persica* are still used in many developing countries due to their low cost and religious background. *Salvadora persica* displays precious biotherapeutics capacity for antimicrobial, antiviral, antioxidant, and anti-inflammatory effects. Recently, a lot of *Salvadora persica* extract has been found in dentifrices, mouthwash, chewing gum, and even local delivery drugs such as periodontal chips, which are still in the research stage. The present review aims to summarize the evidence of various pharmacological and therapeutic aspects of the effectiveness of *Salvadora persica* in promoting periodontal health and the treatment of periodontal disease.

Keywords: periodontal disease, chewing sticks, *Salvadora persica*, periodontitis

ABSTRAK

Penyakit periodontal merupakan beban global yang berdampak pada kesejahteraan dan kualitas hidup yang berhubungan dengan kesehatan. Kontrol plak yang memadai secara rutin sehari-hari adalah hal terpenting untuk mencapai kesehatan periodontal. Penggunaan sikat gigi yang dikombinasikan dengan pasta gigi adalah salah satu metode pemeliharaan kebersihan mulut yang paling umum. Namun, bahan kunyah alami seperti *Salvadora persica* masih digunakan di banyak negara berkembang karena biayanya yang rendah dan latar belakang agama. *Salvadora persica* menampilkan kapasitas bioterapi yang sangat berharga seperti efek antimikroba, antivirus, antioksidan, dan anti-inflamasi. Saat ini banyak ditemukan ekstrak *Salvadora persica* dalam bentuk pasta gigi, obat kumur, permen karet, bahkan obat pengantar lokal seperti periodontal chips yang masih dalam tahap penelitian. Tinjauan ini bertujuan untuk merangkum bukti dari berbagai aspek farmakologi dan terapeutik dari efektivitas *Salvadora persica* dalam meningkatkan kesehatan periodontal dan perawatan penyakit periodontal.

Kata Kunci: penyakit periodontal, tingkat kunyah, *Salvadora persica*, periodontitis

1. Introduction

Periodontal disease is considered one of the most common chronic dental diseases.¹ Periodontal disease is one of the oral diseases found in 90% of the global population. Severe periodontal disease affects nearly 10% of the global population.² Periodontal health is a component of overall health and a fundamental human right.³ Periodontal disease is an infectious disease characterized by inflammation of the tooth-supportive tissues, involving the gingival tissue, alveolar bone, cementum, and periodontal ligament, which can lead to the destruction of the periodontal ligament and alveolar bone and possibly also to tooth loss.³ As has been documented over the years, periodontitis is a multifactorial disease involving a microbial challenge, a host immune-inflammatory response, other local factors, and genetic factors.⁴ Several suspected pathogens have been identified to be involved in destructive periodontal disease. The species most commonly found in periodontal disease include *Aggregatibacter actinomycetemcomitans* (Aa),

Porphyromonas gingivalis (Pg), *Tannerella forsythia* (Tf), *Treponema denticola* (Td), *Fusobacterium nucleatum* (Fn), *Prevotella intermedia* (Pi), *Campylobacter rectus* (Cr) and *Eikenella corrodens* (Ec).⁵

Periodontal disease is treated by eliminating bacterial and inflammatory products through mechanical or chemical methods.¹ The periodontal treatment utilizes a plethora of therapeutic interventions to achieve these goals, including behavioral-change techniques, such as individually tailored oral-hygiene instructions; smoking-cessation support; dietary intervention; subgingival instrumentation to remove plaque and calculus; local and systemic pharmacotherapy; and various types of surgery.³

The incidence of caries and periodontal disease is greatly influenced by adequate plaque removal. Home-care oral hygiene practices are the mainstay of plaque removal, and their frequency and duration have been positively correlated with the incidence of caries and periodontal diseases.⁶ Scaling and root planning have become the gold standard in nonsurgical periodontitis mechanical therapy.⁷ However, mechanical debridement may fail to remove pathogenic organisms because of their location in subepithelial gingival tissue and nontental biofilms (e.g., tongue, oral mucosa).^{3,8} Systemic antibiotic therapy, such as penicillin, tetracycline, and metronidazole, can also potentially suppress periodontal pathogens. However, inappropriate antibiotic therapy may adversely affect human microbial ecology and give rise to antibiotic resistance.^{8,9} They have the drawback of developing gastrointestinal disturbances and drug resistance, and they also fail to achieve adequate concentration at the site of action.⁹

People are turning back to nature for solutions to various ailments. Various herbal products are used nowadays.⁹ Herbal medicines and preparations comprise plant constituents professed to have therapeutic benefits. Herbal products are favored over conventional drugs owing to extensive natural activity, advanced safety margin, and inferior costs.¹⁰ This aimed to avoid the various adverse outcomes of modern chemical therapeutics, including the mentioned side effects of antibiotics, tooth and tongue discoloration, taste alteration, and the financial burden caused by the high cost of the drugs.¹¹ Consequently, the WHO has inspired developing nations to embrace therapeutic herbs as an additional resource to upsurge the success of healthcare systems.⁷ In many developing countries, natural methods of tooth cleaning using chewing sticks, selected and prepared from the twigs, stems or roots of a variety of plants species are still being practiced stems or roots of a variety of plant species are still being practiced due to their availability, low cost, and simplicity.¹² Amongst the evidence-based plant therapies, positively graded as a "miracle twig," is *Salvadora persica*.⁷

Miswak chewing sticks are trendy in Arab culture. They are obtained from the Arak tree (*Salvadora persica*), mainly in Saudi Arabia and several parts of the Middle East. The *Salvadora persica* extract is also commonly used in several commercially available dentifrices, mouthwash, and chewing gum for its intense antiplaque and antimicrobial action.¹⁰ *Salvadora persica*, is a member of the plant family Salvadoraceae. It is mainly distributed in dry and subtropical regions of Africa, the Middle East, and the Indian subcontinent.^{7,13} The use of herbal formulations to positively influence oral health was evident in dentifrices, mouthwash, dental floss, and periodontal chips.¹² *Salvadora persica* has been recommended and encouraged to use as follows: Its potential role in promoting oral health by WHO.¹⁴ *Salvadora persica* has been reported to comprise a wide variety of organic and inorganic compounds within its extract.¹²

The *Salvadora persica* (miswak) benefits dental health in general and oral hygiene specifically by a combination of its mechanical action and pharmacological properties.¹⁵ These contain chemically active substances such as tannins that inhibit glucosyltransferase enzyme to decrease plaque and periodontal diseases and resins that protect against dental caries. Moreover, the antimicrobial, anti-inflammatory, and antioxidant activities of *Salvadora persica* have been ascribed to several detectable substances in its natural extracts, such as potassium and sodium chloride, as well as salvadorine, vitamin C, Salvador, silica, saponins, and different minerals.⁷ Regarding oral health, *Salvadora persica* has been reported to be antibacterial, antifungal, anticariogenic, and antiplaque. Other reported pharmacological properties of *Salvadora persica* include hypolipidemic, antiulcer, anticonvulsant, antifertility, and antioxidant.¹²

Based on this description, the present article is an attempt to provide a comprehensive overview of the various therapeutic effects of *Salvadora Persica* to maintain periodontal health and its enormous contribution to periodontal disease.

2. Literature Review

2.1. Plant Description of *Salvadora persica*

There are around 182 species of plant from which a miswak can be prepared, but the popular choice is *Salvadora persica* all over the world.¹⁵ *Salvadora persica*, is plant species of the Salvadoraceae family. In English, *Salvadora persica*, or the Arak tree, is known as the "toothbrush tree." ^{13,16} 'Miswak' or 'arak' in Arabic is also known by various other names, such as 'koyoji' in Japanese, 'mastic' in Latin, 'gesam' in Hebrew, 'qisa' in Aramaic, 'peelu' in Urdu, and 'kayu sugi' in Malaysia and Indonesia.¹⁷ It is an upright evergreen that grows as a small tree with a crooked trunk. It is seldom more than one foot in diameter, reaching a maximum height of 3 meters. ^{13,16} This tree has thick, small, rounded leaves that smell strongly of cress. The fragrant flowers are very small. The fruit, which resembles a fleshy berry, is small and can be eaten fresh and dried. The plant can live in harsh conditions and tolerate soils ranging from intensely dry to highly saline.^{7,13,16} It is widely distributed in the drier parts of India, Baluchistan, and Ceylon, as well as the dry regions of West Asia and Egypt.¹³ The twigs, stems, and roots of this plant have been used extensively for oral hygiene measures, and also smaller sticks are being used as toothpicks.¹⁵

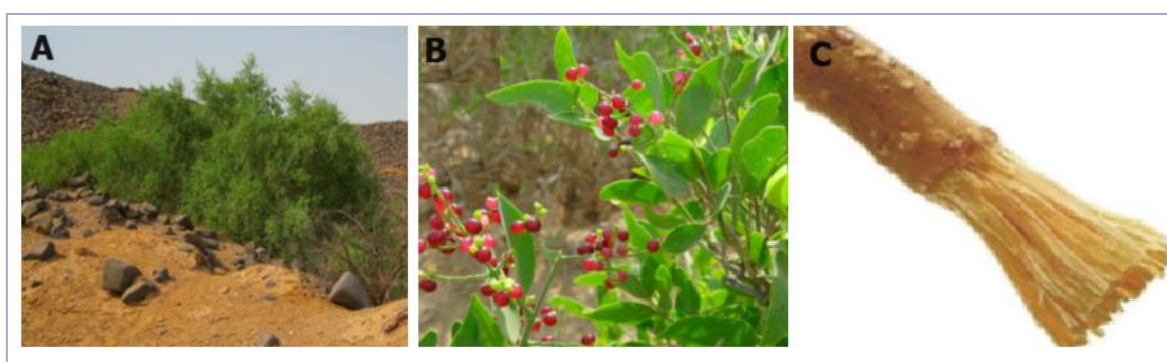


Figure 1. *Salvadora persica*. (a) *Salvadora persica* shrub on a low-level hill in Gohfa Valley, Rabigh. (b) Fruits of *Salvadora persica* during fruiting season. (c) Miswak is used as an oral hygiene aid.^{17,18}

2.2. The Chemical Compound And Its Biological Activity of *Salvadora persica*

Researchers have identified a variety of natural bioactive components in *Salvadora persica* extracts.¹⁶ Recent comprehensive examinations of *Salvadora persica* revealed a secondary metabolite profile.⁷ It was reported that *Salvadora persica* extract containing various organic compounds like flavonoids, salvadorine, cyanogenic glycosides, lignans, saponins, alkaloids, tannins, linoleic acid, stearic acid, salvadoura, and others.²⁰ These constituents are considered to be essential for periodontal.¹⁶ The name and functions of the different bioactive components are discussed in Table 1.

Table 1. Pharmacological Benefits of Metabolites Present in the *Salvadora persica*

Chemical compounds	Pharmacological benefits
Salvadorin alkaloid and salavadorena	Antibacterial effect ^{7,21} Antifungal effect ¹⁶ Stimulatory effects on gingiva ^{7,16} Cytotoxic activity ¹⁶
Benzyl nitrate and Benzyl isothiocyanate (Free and Bound form)	Antibacterial effect ^{16,21} Antiviral effect ^{7,16} Prevent carcinogenic and genotoxic compounds ¹⁶
Silica and Tannin	Acts as an abrasive material to remove plaque and stains on the teeth ^{16,21} Anti-gingivitis and Antiplaque ^{16,21} Antifungal effect ¹⁹ Reduces <i>Candida albicans</i> counted when denture bases were treated with tannic acid ¹⁶
Chlorides and Fluorides	Inhibits the formation of calculus ^{16,19} Remineralization of Enamel and Anti-cariogenic effects ^{13,16,21}
Essential oils	Buffers the pH of saliva ²¹ Possess a characteristic aroma, exert carminative & Antibacterial effect and stimulate the flow of saliva ^{7,16}
Butanediamine	Antibacterial effect ²¹

Chemical compounds	Pharmacological benefits
N-benzyl-2-phenylacetamide	Antimicrobial effect ²¹
β sitosterol	Inhibits human collagen-induced platelet aggregation ¹⁶
Glycosides (salvadoside and salvadorasie)	Inhibits the carcinogenic and genotoxic compounds ²¹
Vitamin C	Antibacterial effect and stimulatory action on the gingival ²¹
Sulfur	Tissue repair and healing, antiscorbutic property to cure the spongy and bleeding gums ^{16,21}
Trimethylamine	Antibacterial effect ^{16,21}
Resins	Decreasing plaque formation antiphlogistic, antibacterial, and gingiva-stimulating effects ^{16,21}
	Protect the enamel ²¹
	Has a protective action against dental caries by forming a layer over the enamel surface ¹⁶
Persicaline	Strong antioxidant properties ^{7,22}

Benzyl isothiocyanate, the main component of *Salvadora persica*, exhibits strong bactericidal effects against periodontal pathogens as well as against other Gram-negative bacteria.²³ It can penetrate the outer membrane of bacteria and can suppress the bacterial redox system by damaging the membrane potential because of its lipophilic and electrophilic properties.^{24,25}

2.3. The Role Of *Salvadora persica* (Miswak) for Periodontium

The primary causative factor of periodontal disease is dental plaque. The effective removal of dental plaque can arrest the process of periodontal disease.²⁶ Many researchers examined the effects of miswak on gingival and periodontal health.¹⁶ Miswak has been well known to play a role in plaque prevention as an antimicrobial agent that inhibits the growth of many plaque-induced bacteria. Plaque is the biofilm layer formed on the teeth' surface that comprises components of saliva, bacterial cells, and their secretions.¹²

2.4. *Salvadora persica* (Miswak) as antimicrobial

Research has indicated that compounds and minerals with antibacterial activities against various oral cavity cariogenic bacteria species are present in *Salvadora persica*.²⁵ Miswak has been endowed with the property of ceasing the growth potential of bacteria causing periodontal disease and dental caries. The antimicrobial effects of miswak can inhibit the growth of *A. actinomycetemcomitans* and *Porphyromonas gingivalis*, a pathogenic bacteria causing periodontal disease.^{19,27} Some in vitro studies have shown that *Salvadora persica* extracts inhibited the growth of various oral aerobic and anaerobic bacteria.²⁸ An in vitro study showed that the whole miswak pieces (without extraction) embedded in agar or suspended above the agar plate had strong antibacterial effects against bacteria implicated in periodontitis and caries progression (*Streptococcus mutans*, *Lactobacillus acidophilus*, *Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis*, and *Haemophilus influenzae*).¹⁹

Salvadora persica extracts and volatiles contained one major antibacterial component, benzyl isothiocyanate, with a rapid bactericidal effect against all Gram-negative bacteria including periodontal pathogens.²⁴ Studies have indicated that Miswak (*Salvadora persica*) possesses antifungal properties. Extract of dry *Salvadora persica* stems demonstrated the highest inhibitory activity against *Candida albicans*, *Candida glabrata*, and *Candida parapsilosis* strains (with a zone of inhibition range of 10.33-15 mm) using an extract concentration of 300 mg/ml.¹⁶ In another study, miswak pieces were uniformed by size and weight and tested against *Streptococcus mutans*, *Lactobacillus acidophilus*, *Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis*, and *Haemophilus influenzae*. Results found that the antibacterial solid effects against all bacteria tested are due to the presence of volatile active antibacterial compounds.¹³

2.5. *Salvadora persica* (Miswak) As Antioxidant and Anti-inflammatory Effect

Inflammatory reactions and the generation of reactive oxygen species (ROS) have been linked as essential factors in the pathogenesis and progression of periodontal disease. In multiple studies, *Salvadora persica* has been discoursed as an antioxidant and anti-inflammatory agent with therapeutic effects.⁷ Antioxidants are vital substances that can protect the body from damage caused by free radical-induced oxidative stress.¹⁶ Excessive free radicals in the body can lead to oxidative stress and may cause many chronic diseases.²⁵ Fortunately, the *Salvadora persica* antioxidant potency has been demonstrated via an impressive collection of standard tests. Recent evidence has been obtained by documenting the antioxidant activities of an ethanol extract, its

many fractions, and some isolated compounds, particularly of a new compound, persicaline.²² Many in vitro studies, such as 1,1-diphenyl-2-picrylhydrazyl [DPPH], superoxide anion, and nitric oxide radical-scavenging methods, have been utilized to prove the antioxidant activities of the fractions and isolated compounds. Persicaline exhibited promising antioxidant activity, with half maximal inhibitory concentrations [IC₅₀] of 0.1, 0.08, and 0.09 mM in the three assays, respectively, which were comparable to those of vitamin C.²⁵

Salvadora persica has also been confirmed experimentally to demonstrate effective anti-inflammatory outcomes supporting its antioxidant mechanisms. It redesigns the nitric oxide synthase (NOS) isoforms. It suppresses pro-inflammatory cytokines such as IL-1 β , IL-6, IL-8, TNF- α , and IFN [7], with a simultaneous release of α -Amylase enzyme promoting anti-inflammatory and anti-oxidative effects at the site of inflammation.^{7,16} It can be used effectively as a natural tool for tooth cleaning and as a natural analgesic for treating toothaches.¹⁶ The analgesic effect of siwak is also shown by a study that is a decoction of miswak when injected into rats. The study showed that miswak is more effective against thermal stimuli than against chemical stimuli.¹³

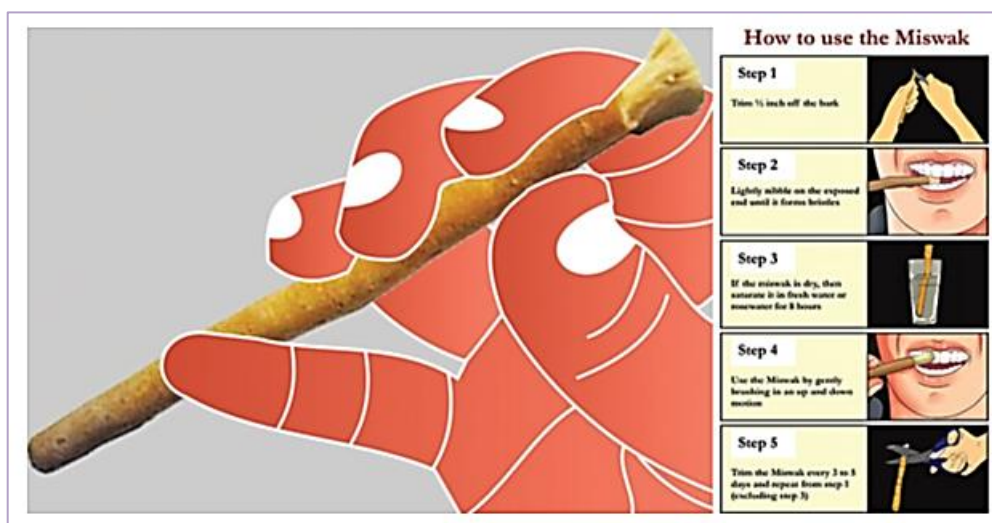


Figure 2. Manipulation of miswak for oral hygiene maintenance.¹⁹ How to use miswak. Step 1 (Trim ½ inch off the bark), Step 2 (Lightly nibble on the exposed end until it forms bristles), Step 3 (If the miswak is dry, then saturate it in freshwater or rosewater for 8 hours), Step 4 (Use the miswak by gently brushing in an up-and-down motion), Step 5 (Trim the miswak every 3 to 5 days and repeat from step 1)

Both techniques aim to ensure that all teeth surfaces are accessible and cleaned conveniently and control the movements of the stick in the oral cavity. To clean the tooth surfaces, the fibers of miswak should be held perpendicular to the tooth surface and gently moved in up and down motions, directed away from the gingival margins on both the buccal and lingual surfaces (Figure 2).^{19,23} According to a study conducted in Sudanese, the adult Sudanese population using miswak or a modern toothbrush regularly was examined using clinical and microbial parameters. The results indicate that regular use of miswak has a significant inhibitory effect on the levels of some salivary and subgingival plaque bacteria Sudanese regular miswak users have better oral health and lower levels of oral pathogens than have adult Sudanese who use a modern toothbrush regularly.²⁸ Miswak and toothbrushes have different designs, but similar functions. In contrast to the conventional toothbrush, the bristles of the miswak are situated along the long axis of its handle. As a result, there is reduced access to the lingual surfaces or the interdental spaces, but the facial surfaces of the teeth can be reached more quickly. Thus, it may not be possible for miswak users to access all surfaces of the dentition. On the other hand, angulating a toothbrush allows the user to reach distal tooth surfaces, particularly on the posterior teeth, with greater ease.¹⁶

2.6. *Salvadora persica* (Miswak) Dentifrices

Miswak-incorporated dentifrices can be found prevalently in the market nowadays. The samples product content of *miswak* to dentifrices in the market is: English (Sarkan), Switzerland (Quali-Meswak), Egypt (Epident), Pakistan (Fluoroswak and *Miswak*), Saudi Arabia (Dentacare

Miswak Plus), and Indonesia (Siwak).³¹ In terms of plaque reduction, their triple-blind, parallel-arm RCT of 330 healthy children compared the efficacy of miswak-incorporated dentifrices and fluoridated dentifrices. They found significantly greater plaque reduction was achieved with the miswak-incorporated dentifrices compared to the conventional fluoridated dentifrices. Miswak-incorporated dentifrices have also been compared with other herbal dentifrices, namely the tea tree oil-incorporated dentifrices.¹² Based on the study, Varma et al, concluded that miswak dentifrices were superior to tea tree oil in plaque reduction.³²

2.7. *Salvadora persica* (Miswak) Mouthwash and Chewing gum

Although mechanical plaque control is the most effective method of plaque removal, mechanical removal alone is insufficient to control plaque as some residual plaque is frequently left behind after brushing and flossing. Mouthwash has been established to be an effective method for plaque reduction.³³ Chlorhexidine has been reported to cause many side effects.³ Consequently, the search for a natural alternative for mouthwash formulation was needed.¹² Niazi et al. conducted a double-blind RCT to compare the efficacy of Chlorhexidine, cetylpyridinium, *Salvadora persica*, and *Azadirachta indica* mouthwash on plaque reduction among 80 patients who underwent orthodontic treatment. Mouthwash formulated with miswak, showed a maximum reduction in the plaque scores among orthodontic patients.³⁴ Miswak has also been reinforced into chewing gum.¹² The study of miswak chewing gum by Amoian et al. showed no significant difference in terms of plaque reduction between all groups. Use of miswak chewing gum demonstrated significantly greater gingivitis reduction in the presence or absence of teeth scaling.³⁵

2.8. *Salvadora persica* (Miswak) Local Drug Delivery

Administering high doses of systemic antibiotics to a large number of patients may cause a variety of side effects.⁷ Therefore, localized drug distribution within periodontal pockets resulted in fewer unwanted side effects, superior worth, higher drug doses at the target site over longer periods, and improved patient compliance.^{7,9,36,37} Local drug distribution for antibacterial agents and other forms of chemotherapeutic mediators in periodontal therapy can be achieved by the local application of topical oral gels and solutions or by the introduction of unique delivery systems into periodontal pockets, such as periodontal chips, for a sustained release of the necessary medication concentrations.^{7,37}

Subgingival applications of Chlorhexidine (CHX) gel are commonly used as an adjunct in nonsurgical periodontal treatment (NSPT) for chronic periodontitis.³⁸ Because of the many side effects of modern chemotherapeutics, such as drug resistance,^{2,9} Therefore, Sekar S formulated the miswak raw extract containing film that can act against *P. gingivalis* and HSV-1. So, it can be used to treat chronic periodontitis by placing it in periodontal pockets.⁹

3. Material and Methods

3.1. Study Design

This study was conducted as a literature review to evaluate the effectiveness of *Salvadora persica* (miswak) on periodontal health. The review includes an analysis of various studies published within a specific time frame, focusing on how the use of miswak contributes to oral health, particularly periodontal health.

3.2. Data Sources

Data were obtained from widely accessible electronic databases, including Medline via Ebscohost, Scopus, Google Scholar, and other database sources. These databases were selected based on their ability to provide access to high-quality research articles relevant to the topic of review. The search was conducted systematically to ensure comprehensive coverage.

3.3. Inclusion and Exclusion Criteria

To ensure that this literature review only includes relevant and high-quality research, specific inclusion and exclusion criteria were applied. Studies were included if they met the following criteria: Original research articles, systematic reviews, or clinical trials published in English, Directly addressed the effectiveness of *Salvadora persica* (miswak) on oral health, particularly in the context of periodontal disease or periodontitis. Studies that did not meet these

criteria, such as references not directly related to the effects of *Salvadora persica* on oral health, editorials, opinion pieces, or references that could not be accessed in full text, were excluded from the review.

3.4. Literature Search Process

The literature search was conducted using a combination of keywords that included terms representing miswak from *Salvadora persica* ("Miswak" OR "Salvadora" OR "persica") and terms related to oral health ("periodontal disease" OR "periodontitis"). This search covered publications from 2005 to 2021 to provide a more comprehensive overview of the topic.

3.5. Data Extraction and Synthesis

After the search process was completed, data from relevant articles were extracted and synthesized narratively. The extracted data included information on study design, the population studied, reported outcomes, and the clinical implications of miswak use on periodontal health. Where possible, quantitative data were also extracted to provide a more in-depth analysis. This narrative synthesis provided specific insights and an overview of the effectiveness of miswak in maintaining periodontal health.

4. Results and Discussion

Progression of gingivitis to periodontitis has been reported due to the predominance of Gram-negative bacteria.³⁹ Miswak exhibits potent antimicrobial activity against Gram-negative pathogens including, *Actinomyces actinomycetemcomitans*, *Porphyromonas gingivalis*, *Haemophilus influenza*, and *Salmonella enteric* pathogenic bacteria causing periodontal disease.^{26,27} Al-Otaibi et al. observed a comparison of miswak and toothbrush users and found a significant decrease in the number of *Actinomyces actinomycetemcomitans* in the subgingival area. In addition, *Salvadora persica* extract can also damage the growth and leukotoxicity of *A. actinomycetemcomitans* bacteria. Al-Otaibi et al. also conclude that in the case of plaque reduction and gingivitis, miswak is at least as effective as brushing teeth. Still, the antimicrobial effect of *Salvadora persica* is very beneficial for the prevention or treatment of periodontal disease.⁴⁰ While, in the study, Rifaey et al. compared the efficacy of miswak chewing sticks as an oral hygiene aid with toothbrush users, there was no significant difference in the microbial counts of *S. mutans* and *A. actinomycetemcomitans* between the two groups at the end of the study period.⁴¹ The present study compared the significant improvements in the clinical measurements observed while using toothbrush and miswak as compared to only toothbrush use.⁴¹

Salvadora persica alcoholic extract produced remarkable antibacterial activity *in vitro* at 10 mg/ml concentration, and is well tolerated and safe. Extract miswak compared the bactericidal activity of alcoholic and aqueous extracts of miswak and found that the alcoholic extract was more bactericidal than the aqueous extract.²³ The study by Abhary showed that miswak contains more than one type of antimicrobial agent that inhibits the growth of Gram-positive and harmful bacteria. The results showed strong antimicrobial activity in the aqueous extract and less activity in alcoholic and nonpolar extracts.⁴² Albabtain reported there were no species that showed a similar change after the use of active miswak. There were no significant differences between active and inactive miswak regarding the registered clinical variables.²⁰

Based on the Yamani study, respondents were divided into two groups, 54 students brushing their teeth using miswak and 55 students brushing teeth *bass* method. The results showed *bass* method group has a lower plaque score than the miswak group. This study showed that using toothbrushes with the *bass* method is superior to using miswak.⁴³ Malik et al. conducted a survey that miswak has revealed parallel and at times greater mechanical and chemical cleansing of oral tissues compared to a toothbrush. The antiplaque efficacy of miswak was significantly demonstrated in this study. This indicates that it may effectively and exclusively replace the toothbrush.⁴⁸ Patel et al held a study to clinically evaluate the effect of miswak as an adjunct to tooth brushing on plaque levels and gingival health in subjects diagnosed with mild to moderate chronic generalized marginal gingivitis compared to those of toothbrush users. This study showed significant improvement in plaque score and gingival health when miswak was used as an adjunct to tooth brushing.⁴⁵ While the survey of Baeshen et al. reported no significant difference between miswak and toothbrushing was found regarding plaque removal on buccal and lingual surfaces. Miswak impregnated with 0.5% NaF and toothbrushing results in comparable plaque removal and

about the same fluoride concentration in saliva, even it was somewhat higher for impregnated miswak.⁴⁶

Azaripour et al. compared miswak extract-containing dentifrices, herbal dentifrices, and conventional dentifrices. Using each of the three tested dentifrices caused a significant reduction in gingival inflammation and amount of plaque. The miswak extract-containing dentifrices showed a similar effect as the herbal dentifrices and can be safely used for domestic oral hygiene in patients with gingivitis.⁴⁷ Varma et al., conducted plaque scores showed a reduction in plaque index after using either of the two herbal-based kinds of dentifrices; however, when compared with Tea Tree Oil, Miswak-based dentifrices resulted in significantly less plaque.³²

Abdulbaqi et al. reported reduced plaque accumulation and a significant difference between *Salvadora persica* and green tea mouthwash compared to Chlorhexidine and placebo.⁴⁸ Research by Aspalli et al. Herbal mouthwash containing *Salvadora persica*, *Bibhitaka*, *Nagavalli*, *Gandhapurataila*, *Ela*, *Peppermint satva*, *Yavani satva* showed effective in the treatment of plaque-induced gingivitis in Group B (Scaling Root Planing + herbal mouthwash) when compared with the Group A (Scaling Root Planing alone) on reduction of plaque and gingivitis.⁴⁹ But in the study Almas K et al. assessed the antimicrobial activity of eight commercially available mouth rinses (Corsodyl, Alprox, Oral B advantage, Florosept, Sensodyne, Aquafresh mint, Betadine, and Emoform) and 50% miswak extract against several microorganisms. It was observed that mouth rinses containing Chlorhexidine had maximum antibacterial activity, while cetylpyridinium chloride mouth rinses were moderate, and miswak extracts had low antibacterial activity.⁵⁰ As plaque control is essential for preventing inflammatory periodontal diseases, mouthwashes can prevent plaque formation and thus help maintain a healthy periodontium. Based on Prasad study et al. Chlorhexidine Gluconate and herbal mouthwash (*Hiora* contain *Nagavalli*, *Salvadora persica*, and *bibhitaka*) showed similar antiplaque activity with no side effects.⁵¹

Sekar S formulated the miswak raw film periodontal extract that can act against *P. gingivalis* and HSV-1. So it can be used to treat chronic periodontitis by placing it in periodontal pockets.⁹ While the study by Niazi et al. assessed the clinical efficacy of photodynamic therapy (PDT) and *Salvadora persica* gel as adjuncts to scaling and root planning (SRP) in treating chronic periodontitis, Both the treatment modalities PDT and *Salvadora persica* helped in reducing periodontal inflammation. PDT reported a significant gain in clinical attachment level, whereas the *Salvadora persica* significantly reduced the bleeding levels.⁵²

5. Conclusion

Salvadora persica exhibits beneficial effects on maintaining periodontal health and enormously contributes to periodontal disease. The use of chewing sticks as an adjunct to toothbrushes may contribute to preventing oral diseases. More and more studies should focus on the clinical effectiveness of *Salvadora persica* compared to the toothbrush on clinical periodontal parameters such as probing depth, bleeding on probing, and clinical attachment level. The effect of *Salvadora persica* should be evaluated separately on periodontally healthy and diseased individuals. Hence, *Salvadora persica* use should be encouraged and promoted based on scientific knowledge of its numerous therapeutic effects on oral health, easy availability, popularity, and low cost. However, achieving the optimum impact of miswak (*Salvadora persica*) depends on its regular use with proper and practical techniques.

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Authors Contribution

Contribution	Ersa S	Ervina I
Concepts or ideas	√	
Design	√	√
Definition of intellectual content	√	√
Literature search	√	√
Experimental studies		
Data acquisition	√	√
Data analysis	√	√
Statistical analysis		
Manuscript preparation	√	√
Manuscript editing	√	√
Manuscript review	√	√



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