

Therapeutic effects of *Salvadora persica* (Miswak) on patients with mild to moderate gingivitis

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Background and Objectives: Miswak is the public name of *Salvadora persica*, which is beneficial for dental treatments and can thus be used to treat gingivitis. This study compares the therapeutic effects of miswak (*S. persica*), toothbrush, *S. persica* mouthwash, and chlorhexidine mouthwash on patients with mild to moderate gingivitis by estimating gingival index and (debris) plaque index.

Patients and Methods: The study is a selective sampling, cross-sectional, clinical comparative study of 50 systemically healthy patients in Erbil city. The patients were divided randomly into five groups, with each group having 10 patients. Group 1 used *S. persica* chewing stick only; group 2 used toothbrush only; group 3 used both *S. persica* and toothbrush, group 4 used *S. persica* mouthwash and toothbrush; while group 5 used chlorhexidine mouthwash and toothbrush. The patients' mouths were examined, recording clinical indices before and after four weeks from the administration of treatments.

Results: There is significant improvement observed between groups 3 and 1 and groups 3 and 2 regarding gingival index. Moreover, there is significant improvement in debris (plaque) index between groups 2 and 3 and groups 2 and 1.

Conclusion: The gingival index indicates that using *S. persica* and toothbrush together is better than using *S. persica* or toothbrush alone. Meanwhile, the debris index shows that using *S. persica* alone or using it with toothbrush is more effective than using toothbrush alone.

Keywords: *Salvadora persica*, gingivitis, gingival index, debris index.

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Introduction

Oral hygiene is essential because it has a direct impact on our general health; therefore, maintaining good oral hygiene is very important as it prevents any contamination through the mouth. There are several ways of practicing good oral hygiene. The most popular methods are using a toothbrush with dentifrice and using miswak (*Salvadora persica*).^{1, 2}

Approximately 7,000 years ago, the Babylonians used miswak.³ The use of miswak among Muslims is largely due to religion. Muslims have used miswak for approximately 1,000 years. The prophet Muhammad (Peace be upon him) recognised its benefit in keeping the mouth clean.^{4, 5}

The name miswak comes from the Arabic language, which means a chewing stick used for cleaning the mouth(1), and it is the public name for *Salvadora persica*.⁶

Miswak is obtained from the *Salvadora persica* tree, particularly from its roots or twigs.⁷ The tree is medium sized, and it grows in Middle East countries, especially in Saudi Arabia.^{5, 8} *Salvadora persica* is a sand selective halophytic tree. It contains many compounds, such as sodium chloride, potassium chloride saponins, trimethylamine tannins, stearic acids, B-sitosterol, resins, and sulfur. It also contains Salvadorian, alkaline, essential oil, silicon, vita-

min C, fluoride, and cyanogenic glycosides.^{4,6-12}

Salvadora persica is beneficial for dental treatment because it contains as antifungal, anti-inflammatory, analgesic, antibacterial, antiplaque, antiulcer, and anticaries properties. It can be used to treat gingivitis and periodontitis that cause diseases in the oral cavity, such as *Staph. aureus*, *Strep. mutans*, *Staph. faecalis*, *S. pyogenes*, *Lactobacillus*, and *C. albicans*, through its antibacterial and antifungal properties and its dental-plaque-inhibiting compounds.^{4,7,13}

Moreover, the benzyl isothiocyanate isolated from the *S. persica* has antiviral properties against HSV-1 and acts as an agent to control dental caries.^{5,14} *S. persica* also stimulates the salivary gland to secrete more saliva.^{4,15} In addition, *S. persica* can be used as toothpaste, mouthwash, or gargle because of its activity against bacteria that cause dental plaque and against halitosis and because it has a compound that can make teeth whiter.^{9, 14, 16-18}

Salvadora persica has not received much attention in Iraq in treating various oral diseases such as gingivitis and periodontitis. This study, therefore, is an attempt to encourage patients to use *S. persica*, demonstrate the correct way of using *S. persica*, and describe the effects of *S. persica* on gingivitis.

This study was designed to assess the therapeutic effects of *Salvadora persica* chewing stick on patients with mild to moderate gingivitis and to compare its effects with chlorhexidine mouthwash, *S. persica* mouthwash and toothbrush, through estimating gingival index and debris (plaque) index.

PATIENTS AND METHODS

The present study is a selective sampling, cross-sectional, clinical comparative study of 50 patients in Erbil City. The 50 patients have mild to moderate gingivitis and were divided randomly into 5 groups with 10 patients each: The 1st group used *Salvadora persica* chewing stick only without tooth brushing two times daily for at least two minutes; the 2nd group used toothbrush only; the 3rd group used both *S. persica* and toothbrush; the 4th group used *Salvadora persica* mouthwash and toothbrush; and the 5th group used chlorhexidine (0.12%)

mouthwash and toothbrush.

All the patients that used toothbrush used the same type of toothbrush (Banner) and the same type of toothpaste (Sensodyne) and advised to use it two times daily for at least two minutes. All the patients that used chlorhexidine mouthwash used the same type (ZAK).

The *Salvadora persica* mouthwash prepared by standing a dedicated stick in a glass containing a few centimeters of water, then the sap starts releasing straight away and within an hour or two you will have a top full strength mouthwash.¹⁹ Two videos prepared; one of them for how to use *Salvadora persica* as chewing stick and the other for how to prepare the *Salvadora persica* mouthwash to become easy to the patients to use them correctly.

All the patients that used mouthwashes (*Salvadora persica*, chlorhexidine (CHX)) used the same dose (10) ml of them for one minute after half hour of tooth brushing two times daily, and they advised to not eat or drink anything at least two hours after mouthwash.

All the patients used materials for four weeks and Informed consent were obtained from all patients accepted to participate in the study.

The patients' mouths were examined and the case sheet filled before and after four weeks of the administration of *Salvadora persica*, toothbrush, both *S. persica* and toothbrush, *Salvadora persica* mouthwash and toothbrush, and chlorhexidine mouthwash and toothbrush.

The patients were evaluated by examining intraoral on the dental chair after air-drying the teeth under good light and using a dental mirror and probe under supervision of specialized dentists (periodontitis).

The following indices were also analysed:

A: Gingival Index

The Gingival Index according to Loe and Silness,^{20,21} was created to assess the severity and quantity of gingival inflammation. According to this method, each of four gingival areas of the tooth was assessed (facial, mesial, distal, and lingual) and given a score from 0 to 3. The criteria are as follows: (0 = Normal gingiva; 1 = Mild gingival inflam-

mation – slight change in colour and slight oedema but no bleeding upon probing; 2 = Moderate gingival inflammation – redness, oedema, and glazing; bleeding on probing; and 3 = Severe gingival inflammation – marked redness and oedema, ulceration with tendency for spontaneous bleeding). The scores for four areas of the tooth was totalled and divided by four to give a tooth score, then by adding the tooth scores together and divided by the number of teeth examined an individual gingival index score was obtained. The classification is as follows : (0= Normal gingiva;0.1–1 = Mild gingivitis; 1.1–2 = Moderate gingivitis;2.1–3 = Severe gingivitis)

B: Debris (plaque) Index. The debris (plaque) index created by Greene and Vermillion^{22–24} indicates debris measures from degree 0 to degree 3 as follows: (degree 0 – absence of plaque, degree 1 – presence of plaque on up to 1/3 of tooth surface, degree 2 – presence of plaque on up to 2/3 of tooth surface, and degree 3 – presence of plaque on more than 2/3 of tooth surface. Plaque sum is counted and classified as: (good (0.0 to 0.6), regular (0.7 to 1.8), or poor (1.9 to 3.0). Six teeth were examined including 16 (upper right first molar), 11 (upper right central), 26 (upper left first molar), 36 (lower left first molar), 31(lower left central), and 46 (lower right first molar), The buccal surfaces of the selected upper molars, the lingual surfaces of the selected lower molars and the labial surfaces of anterior teeth are inspected and the calculation of debris index was as below:

Debris (plaque) Index = (The buccal-scores) + (The lingual-scores) / (Total number of examined buccal and lingual surfac-

es).

Inclusion criteria

1. Patients with mild to moderate gingivitis.
2. Systematically healthy patients.
3. Patients aged between 20 and 50, regardless of gender.

Exclusion criteria

1. Patients with severe gingivitis or periodontitis.
2. Pregnant, lactating and post-menopausal women.
3. Patients with history of periodontal treatments or drug intake for the previous 3_6 months.
4. Alcoholic and smoker patients.

Statistical analysis. The results were evaluated statistically by using Statistical Package for the Social Sciences (SPSS) version 24.0. All the data were expressed as mean \pm SD. Comparisons between groups were done by using Duncan test and Paired t-test. Changes were considered statistically significant when P value was of 0.05 or less.

Chi square test of association was used to compare between proportions. When the expected count of more than 20% of the cells of the table was less than 5, Fisher's exact test was used. Paired t test was used to compare readings before and after the intervention. A p value of ≤ 0.05 was considered statistically significant.

ETHICAL CONSIDERATION:

This approved by ethical committee in college of dentistry, Hawler medical university, Erbil, Iraq.

RESULTS

Fifty patients with mild to moderate gingivitis participated in the study. Their ages range from 20 to 50, with the mean age of

Table 1. Gingival index (GI) of patients before and after the administration of S. persica, toothbrush, both S. persica and toothbrush, S. persica mouthwash and toothbrush, and chlorhexidine

Group	GI Before mean \pm S.D	GI After mean \pm S.D	p-value
S. persica	0.97 \pm 0.45	0.44 \pm 0.34	0.01
Toothbrush	1.06 \pm 0.49	0.71 \pm 0.54	< 0.001
S. persica and toothbrush	1.15 \pm 0.32	0.21 \pm 0.19	<0.001
S. persica mouthwash and toothbrush	0.92 \pm 0.59	0.22 \pm 0.41	<0.001
Chlorhexidine mouthwash and toothbrush	0.68 \pm 0.33	0.19 \pm 0.15	<0.001

33±11.1; for male the mean age was 40±11.1 and for female the mean age was 26±11.1.

Effect of treatments on the indices

1. Gingival index. The analysis of the data regarding the month-long use of *S. persica*, toothbrush, both *S. persica* and toothbrush, *S. persica* mouthwash and toothbrush, and chlorhexidine mouthwash toothbrush revealed significant improvement in the pa-

tients' gingival index as shown in Table 1 with p-value < 0.05.

2. Debris (Plaque) index. The debris (plaque) index showed significant improvement in patients who used *s.persica* for one month as well as those who used both *S. persica* and toothbrush, *S. persica* mouthwash and toothbrush, chlorhexidine mouthwash and toothbrush for one month. Meanwhile, no significance was observed in using

Table 2. Debris (Plaque) index (DI) of patients before and after the administration of *S. persica*, toothbrush, both *S. persica* and toothbrush, *S. persica* mouthwash and toothbrush, and chlorhexidine mouthwash and

Group	DI Before Mean ±S.D	DI After Mean ±S.D	p-value
<i>S. persica</i>	1.42 ±0.48	0.37 ± 0.38	<0.001
Toothbrush	1.17 ±0.62	0.79 ± 0.69	0.066
<i>S. persica</i> and toothbrush	1.68 ± -0.60	0.55 ± 0.48	<0.001
<i>S. persica</i> mouthwash and toothbrush	1.43 ± 0.76	0.69 ± 0.64	0.007
Chlorhexidine mouthwash and toothbrush	1.13 ± 0.45	0.88 ± 0.38	0.034

toothbrush alone for one month as shown in Table 2 with p-value < 0.05 mouthwash and toothbrush.

3. Mean gingival and debris (plaque) score. Table 3 showed the comparison of mean differences of gingival index (GI) and debris(plaque) index (DI) between groups that used *S. persica*, toothbrush, both *S. persica* and toothbrush, *S. persica* mouthwash and toothbrush, and chlorhexidine (CHX) mouthwash and toothbrush and revealed that there was no significant improvement in

gingival index for the group that used toothbrush and the group that used *S. persica* only, but there was significant improvement in those who used *S. persica* and toothbrush together compared with those who used *S. persica* or toothbrush separately.

Moreover, the gingival index showed that there was no significant change when patients use *S. persica* mouthwash or chlorhexidine mouthwash as an adjunct to toothbrush; however, using *S. persica* mouthwash is better than using chlorhexidine mouth-

Table 3. Compares the mean of the indices (GI and DI) before and after administrations of *S. persica*, toothbrush, both *S. persica* and toothbrush, *S. persica* mouthwash and toothbrush, and chlorhexidine (CHX) mouthwash and toothbrush

Indices	<i>S. persica</i> Mean ±S.D	Toothbrush Mean ±S.D	<i>S. persica</i> and Toothbrush Mean ±S.D	<i>S. persica</i> Mouthwash and Toothbrush Mean ±S.D	Chlorhexidine Mouthwash and Toothbrush Mean ±S.D
Gingival index	0.53±0.51 ab	0.35±0.19 a	0.94 ±0.27 c	0.7 ±0.37 bc	0.49±0.28 ab
Debris index	1.05±0.34 b	0.38±0.57 a	1.13 ±0.55 b	0.74 ±0.67 ab	0.43±0.54 a

wash as demonstrated in their mean difference of 0.85 ± 0.4 and 0.47 ± 0.3 , respectively.

Meanwhile, according to the debris (plaque) index, there was no significant improvement when patients use *S. persica* alone or when they use it with toothbrush, but there was significant improvement when they use toothbrush alone or use it with *S. persica*. In other words, using both *S. persica* and toothbrush is better. Moreover, there was significant improvement between the group that used toothbrush alone and the group that used *S. persica* only. Furthermore, when we compare the two groups that used toothbrush but with different mouthwashes – *S. persica* mouthwash and chlorhexidine mouthwash, we observed that there is no significant difference between them. However, using *S. persica* mouthwash is better than using chlorhexidine mouthwash as signified in their mean difference of 0.740.67 and 0.430.54, respectively.

DISCUSSION

The present study demonstrates a significant improvement in the gingival index of patients who have mild or moderate gingivitis in all groups (see Table 1). Meanwhile, according to the debris index, there is significant change in all groups, except the group that use toothbrush alone (see Tables 2). However, when we compare the mean difference in their gingival index, we note a significant improvement when patients use *S. persica* and toothbrush together and when they use *S. persica* or toothbrush separately. The present study has the same result as a study done in 2012.²⁵

The mean difference in the debris (plaque) index in this study also reveals a significant improvement when we compare the group that used both *S. persica* and toothbrush and the group that used toothbrush only, and this reflects the same results as studies done in 2012 and 2016.^{25, 26} Notably, there is no significant improvement when we compare the group that used both *S. persica* and toothbrush together and the group that used *S. persica* alone, and this contrasts with the studies done in 2012 and 2016, both of which reported significant difference.^{25, 26}

Comparing the group that used *S. persica*

alone and the group that used toothbrush only in the present study, we observe that using *S. persica* alone is significantly better than using toothbrush alone as shown in the mean difference of their debris (plaque) index. This contrasts with the results of the two studies done 2012 and 2016, which reported no significant difference.^{25, 26}

The findings of this study regarding the effect of using *S. persica* may be due to the compounds found in it, such as tannins (tannic acid), sulphate compounds, and benzyl isothiocyanate that have antibacterial effect in treating gingivitis as reflected in the gingival index.²⁷ Moreover, tannins present in *S. persica* inhibit the action of glucosyl transferase, thereby reducing the gingival index.¹⁸ Meanwhile, tannic acid has an astringent effect on the mucus membrane and has anti-plaque and anti-gingivitis properties.^{9,15} Similarly, the presence of vitamin C in *S. persica* helps heal and repair tissues^{9,15,18} and strengthens the gingiva capillaries, thus preventing gingivitis.²⁷ In addition, *S. persica* has alkaloid (Salvadorine), which inserts trimethylamine¹⁸ and exerts a bactericidal, vasoconstrictor, or vasodilator stimulatory and analgesic effect on the gingiva.^{9, 12, 15, 18, 28} Likewise, the presence of trimethylamine in *S. persica* helps reduce the debris index by decreasing the debris (plaque) that adheres to the tooth surface.²⁷

The present study is in line with al-Qtaibi *et al.*'s study in 2004²⁹ in gingival index, but contrast in debris (plaque) index, which reported that *S. persica* has the same effect as tooth brushing in reducing the gingival and debris (plaque) indices. The present study is also in contrast with the study done by Mohammed *et al.* (2006)³⁰, which asserts that *S. persica* and tooth brushing have the same effect, both experimentally and clinically, in reducing debris (plaque) index on the buccal surfaces of teeth.

The present study found that using *S. persica* mouthwash significantly decreases the gingival index and the debris (plaque) index, and there is no significant difference between *S. persica* mouthwash and chlorhexidine mouthwash. It is in line with Kaur *et al.*'s study.³¹ In 2012, Poureslami²⁷ found that *S. persica* extract can be used as mouthwash to decrease debris (plaque) and

caries. This may be due to *S. persica*'s antibacterial properties as shown in a study done in 2016,³ reporting that the saliva taken from a patient's mouth after rinsing it with *S. persica* mouthwash shows significant reduction in the total count of bacterial colonies compared to the saliva of the same patient before rinsing. Accordingly, a study demonstrated that gingival health improves when patients use *S. persica* mouthwash compared to those who use the placebo.³² Another study reported that *S. persica* mouthwash decreases gingival and debris (plaque) indices. Conversely, two studies reported that using chlorhexidine mouthwash has more effect and antibacterial properties than using a mouthwash containing miswak extract.^{15,33}

Notably, the study done in 2006 reported that the difference in the means of the anterior labial region for miswak users and toothbrush users in debris (plaque) level is not statistically significant;³⁰ this contrast with the results of the present study, indicating a significant difference between them. The study done by Shah *et al.* reported that there is significant difference in gingival index between the 50th and the 100th day after starting the study between the group that used *S. persica* alone and the group that used both *S. persica* and toothbrush but no significant difference in the group that used toothbrush with toothpaste, whereas in the present study, all three groups have significant difference. Moreover, Shah *et al.* found that subjects who used only miswak did not show any significant difference in the mean values in the debris index when compared at the two intervals; this also contrasts with the findings of the present study, showing all have significant difference.²⁶

CONCLUSION

The present study shows that using *salvadora persica* mouthwash as an adjacent to tooth brushing has the same therapeutic effect as CHX mouthwash on healing mild to moderate gingivitis.

The gingival index indicates that using *S. persica* and toothbrush together is better than using *S. persica* or toothbrush alone. Meanwhile, the debris (plaque index shows that using *S. persica* alone or using it with toothbrush is more effective than using

toothbrush alone.

Conflict of interest

The authors reported no conflict of interests.

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