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 Muslims. 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.5 Miswak is obtained from the Salvadora persica tree, particularly from its roots or twigs.6 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-
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, Strept. mutans, Staph. faecalis, S. pyogenes, Lactobacillus, and C. albicans, through its antibacterial and antifungal properties and its dental-plaque-inhibiting compounds. Moreover, the benzyl isothiocyanate isolated from the S. persica has antiviral properties against HSV-1 and acts as an agent to control dental caries. S. persica also stimulates the salivary gland to secrete more saliva. 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.

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 have a top full strength mouthwash. 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 Löe and Silness, 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-
Information – 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 Vermillion22–24 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 surfaces).

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 ± 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

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

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.
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 patients’ 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 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 mouthwash.

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 toothbrush

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

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        | S. persica | Toothbrush | S. persica and Toothbrush | S. persica Mouthwash and Toothbrush | Chlorhexidine Mouthwash and Toothbrush |
|----------------|------------|------------|---------------------------|------------------------------------|--------------------------------------|
|                | Mean ±S.D  | Mean ±S.D  | Mean ±S.D                 | Mean ±S.D                          | Mean ±S.D                            |
| Gingival index | 0.53±0.51  | 0.35±0.19  | 0.94 ±0.27                | 0.7 ±0.37                          | 0.49±0.28                            |
|                | ab         | a          | c                         | bc                                 | ab                                   |
| Debris index   | 1.05±0.34  | 0.38±0.57  | 1.13 ±0.55                | 0.74 ±0.67                         | 0.43±0.54                            |
|                | b          | a          | b                         | ab                                 | a                                    |
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 a significant change in all groups, except the group that use toothbrush alone (see Table 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 trimethylamine 18 and exerts a bactericidal, vasoconstrictor, or vasodilator stimululatory and analgesic effect on the gingiva.9,12,15,18 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 2004 29 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, Poursalmi 27 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, 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. 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.

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, 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 to the two intervals; this also contrasts with the findings of the present study, showing all have significant difference.

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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