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The effect of using toothpaste with miswak (*Salvadora persica*) on plaque formation and dental caries

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Abstract

Background: The oral cavity is the main entry point for microorganisms. Most of the causes of dental and oral damage are plaque. Plaque that appears in the oral cavity will cause various kinds of dental and oral diseases, such as caries, gingivitis, and periodontitis. Miswak contains antiseptic ingredients, tannic acid, and essential oils that can improve oral health by providing antibacterial effects and preventing a decrease in salivary pH.

Objective: This study aims to determine the effect of using toothpaste with miswak (*Salvadora persica*) content on plaque formation and dental caries.

Method: This research is a review article using secondary data from national and international literature published in 2016-2023.

Results: Several studies have shown that miswak (*Salvadora persica*) has antibacterial properties that can reduce plaque and prevent dental caries in children and adults.

Conclusion: Miswak possesses antifungal, antibacterial, and anti-caries qualities, which have the ability to inhibit the growth of microorganisms that are responsible for maintaining dental plaque and caries.

Keywords: Miswak; Toothpaste; Dental Plaque; Caries

1. Introduction

The standard of oral hygiene is a crucial factor in preserving oral health. The mouth cavity serves as the primary entry point for germs. Oral hygiene is indicated by the presence of organic deposits, including pellicles, alba material, food detritus, calculus, and dental plaque. The primary cause of oral and dental damage is plaque. Dental plaque present in the oral cavity can lead to many dental and oral illnesses, including caries, gingivitis, and periodontitis [1].

Dental caries and periodontal disease can be mitigated with the frequent management of plaque accumulation. Plaque cannot be eliminated merely by cleaning the mouth; it must also be removed by mechanical methods. The most efficient mechanical method for plaque removal remains teeth brushing. Toothpaste serves as an adjunct to toothbrushes in chemically preventing plaque formation. An alternative to toothpaste with antibacterial characteristics is the use of plant extracts, such as siwak [2].

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Siwak (*Salvadora persica*) is a plant species within the Salvadoraceae family. This plant often thrives in the Middle East and has historically used as a toothbrush effective for dental and gingival hygiene. Siwak comprises the stem, root, or twig of the *Salvadora persica* plant, utilized for dental and oral hygiene for around 7,000 years [3]. Miswak comprises antiseptic compounds, tannic acid, and essential oils that enhance dental health by delivering antibacterial properties and inhibiting a reduction in salivary pH. Miswak comprises about 20 compounds, including salvadourea, salvadorine, saponins, tannins, vitamin C, silica, resin, cyanogenic glycoside, and benzylsothiocyanate. Certain chemicals possess antibacterial effects, astringent qualities, and can enhance saliva production. Moreover, miswak possesses antimicrobial properties and cleansing benefits, attributed to its elevated levels of sodium chloride and potassium chloride [2].

2. Material and methods

This study constitutes a literature review. This study utilizes secondary data sourced from three databases: Google Scholar, PubMed, and ScienceDirect. The keywords employed in the journal search included miswak (*Salvadora persica*) toothpaste, dental plaque, and dental caries. This study's inclusion criteria encompassed national and international literature published between 2016 and 2023, focusing on research samples regarding the effects of miswak-containing toothpaste on dental plaque and caries formation.

3. Results

Table 1 Results of a review of research articles regarding effect of using yoothpaste with miswak (*Salvadora persica*) on plaque formation and dental caries

No	Writer	Title	Object	Method	Result
1	Bramanti et al [2]	Efektivitas siwak (*Salvadora persica*) dan pasta gigi siwak terhadap akumulasi plak gigi pada anak-anak	The study was conducted on 39 students of Taruna Al Quran Islamic Boarding School, Lempongsari, Yogyakarta, aged 12-15 years with permanent teeth, male and female were not differentiated, the arrangement of teeth was not crowded, there was no caries in the area to be scored, and did not wear prostheses and orthodontic devices.	Subjects were divided into 3 groups. each subject in the same group was asked to brush their teeth 3 times a day using miswak; miswak toothpaste; and pure toothpaste without additional ingredients as a control. after a week of brushing, plaque scores were measured using the PHP-M index.	The plaque score of the miswak group was significantly higher than that of the pure toothpaste group, but there was no significant difference between the miswak and miswak toothpaste groups.
2	Juliarni et al [4]	Pengaruh Menyikat Gigi dengan siwak (*Salvadora persica*) terhadap pH saliva	Pre-clinical students of FKG Unand class 2014-2015 which amounted to 97 people.	This study uses experimental research with Pre test and Post test Control Group Design to assess the effectiveness of using miswak on salivary pH. The total sample size was 34 people based on the research formula of two independent populations, namely 17 people for each treatment group. The research sample was divided into two	The paired t-test yielded a significance value of p=0.001 in the case group and p=0.000 in the control group. The Mann-Whitney test yielded a significance value of p=0.317. There was no significant difference between these groups.

				groups, the case group used miswak while the control group used a conventional toothbrush, each brushing horizontally for 2 minutes. conventional. Salivary pH measurements were made with a pH meter.	
3	Al-Dabbagh et al [5]	Efficacy of Miswak toothpaste and mouthwash on cariogenic bacteria	The subjects were 40 students in Zakho city, Kurdistan, Iraq between October 2013 and January 2014.	A randomized controlled clinical trial of 40 students was randomly allocated into 4 groups. They were instructed to use miswak toothpaste, miswak mouthwash, and regular toothpaste with water or normal saline. Saliva samples were collected at 3-time intervals: before, immediately after use, and after 2 weeks of use. The effect of each method on Streptococcus mutans and Lactobacilli was evaluated using the caries risk test.	One-way repeated measures analysis of variance (ANOVA), one-way ANOVA, and least significant difference tests were used. Miswak mouthwash had a significant reduction effect on both bacteria immediately and after 2 weeks of use. Miswak toothpaste had a similar effect on Lactobacilli, while Streptococcus mutans showed a significant reduction only after 2 weeks of use. Regular paste showed insignificant effects on both bacteria at both time intervals; while the addition of normal saline showed significant effects on both bacteria only after 2 weeks of use.
4	Sabbagh et al [6]	The effect of brushing with *Salvadora persica* (miswak) sticks on salivary Streptococcus mutans and plaque levels in children: a clinical trial	Male students aged 8 to 10 years from Alshati Public Primary School, in Jeddah, Saudi Arabia, between February and April 2016 with a high risk of clinically detected oral caries	Subjects were randomly grouped into the test (provided with miswak sticks) and control groups (provided with FTP and soft brushes). Both groups were introduced to the preparation period (PPP) for 3 weeks. Plaque scoring and saliva sampling were performed before PPP and in follow-up visits by a single calibrated and blinded dentist.	Both groups showed a statistically significant decrease in the mean plaque score during the study (P = 0.007 and P = 0.001, respectively). In addition, subjects in the test group with abundant S. sanguinis increased from zero to six after 3 months.
5	Bramantoro et al [7]	Miswak users' behavior model	Students of As-Salafi Al Fitrah Islamic	The assessment of respondent	Perceived behavioral control has the most

		based on the theory of planned behavior in the country with the largest Muslim population	Boarding School who consistently utilize siwak and maintain optimal physical and mental well-being. One hundred nine samples were randomly selected to complete semi-structured and closed questions.	characteristics uses semi-open questions, while the assessment of respondent behavior uses closed questions about the use of miswak based on the theory of planned behavior consisting of attitudes, subjective norms, perceived behavioral control, motivation, and miswak use behavior. Researchers analyzed the data using XLstat 2017 by XLstat. Data were presented in tabular form and descriptive analysis in the form of percentages and odds ratio (OR). Multivariate analysis was completed using linear regression.	dominant influence on increasing intention with β=0.211 and p<0.05. In contrast, attitudes and subjective norms have less influence on increasing intention with β=0.190 and p>0.05, and β=0.164 and p<0.0001. Meanwhile, perceived behavioral control showed a direct correlation to action in the model parameters with β=0.445 and p<0.0001.
6	Praptiningsih et al [8]	Uji Efektifitas Ekstrak Siwak (*Salvadora persica*) Berbagai Konsentrasi Terhadap Pembentukan Plak Gigi - Studi terhadap Murid MTsN Sale	The population in this study were all students students of SDN 15 Ampang Gadang, Ampek Angkek, Agam Regency which amounted to 228 people. people.	Comparative analytic research, with a cross-sectional approach. sectional approach. Data collection techniques by direct examination of the sample. Variable The dependent variable in this study is dental plaque score, while the independent variable is toothpaste containing siwak extract. toothpaste containing miswak extract. The sampling technique used was “purposive sampling”, namely selecting samples through inclusion criteria, namely: 1) grade IV and V students who are willing to become 2) students are not in orthodontic treatment 3) present at the time of the study and physically and mentally healthy. and physically and mentally healthy.	The average dental plaque score before brushing was 2.18 with a range of dental plaque scores of 1.2 to 3.6. The highest average frequency of plaque score was 2.1 as many as 8 students (19%). After the tooth brushing activity with toothpaste containing siwak extract with the equation toothpaste containing miswak extract as a whole with the equation of tooth brushing method In class IV and V students, the average dental plaque score after brushing is 0.48, with a range of dental plaque scores of 0.1 to 0.8. The highest frequency of average plaque scores are 0.4 and 0.6 equally as many as 9 students (21.4%).

4. Discussion

From a literature review conducted between 2016 and 2023 using the keywords (miswak, toothpaste, plaque, and caries) in the Google Scholar, PubMed, and ScienceDirect databases, six relevant papers were identified by subject filtering. Plaque is a pliable and adhesive film that clings to the teeth and contains microorganisms. Plaque reduction can be achieved using mechanical methods, such as tooth brushing. Innovations in dentistry have identified toothpaste formulations with miswak (*Salvadora persica*) as a natural component to diminish plaque accumulation on tooth surfaces and avert dental cavities.

Indra Bramanti et al. conducted research with 39 students separated into three groups: pure toothpaste, miswak, and miswak toothpaste. Each participant brushed their teeth three times daily for one week using the assigned toothpaste. The findings indicated that the plaque score of the miswak group exceeded that of the pure toothpaste group. Brushing teeth with miswak can drastically decrease plaque scores more effectively than using conventional toothpaste. Nonetheless, no substantial change was observed between the miswak and miswak toothpaste groups [2].

Research carried out by Juliarni et al. with a total sample size of 34 individuals, who were split into two groups and subjected to experimental research with a pre-test and post-test control group design. A non-parametric technique known as the Mann-Whitney test was utilized in order to assess the data presented on the difference in salivary pH between the miswak group and the control group. Due to the fact that the salivary pH data of both the pre-test and post-test samples of the two groups acquired a p-value that was greater than 0.05, a parametric test was performed using the t-test. The Mann-Whitney test yielded a significance value of p=0.317, whereas the paired t-test yielded a significance value of p=0.001 in the case group and p=0.000 in the control group. A significant difference was found between the two groups. According to this, there is a significantly substantial influence that brushing one's teeth with miswak has on the pH of the saliva [4].

Research by Samim A. Al-Dabbagh et al. involved 40 students randomly assigned to four groups, utilizing miswak toothpaste, miswak mouthwash, conventional toothpaste with water, or normal saline. A one-way repeated measures analysis of variance (ANOVA) was employed. The Miswak mouthwash demonstrated a substantial reduction in bacteria both immediately and after two weeks of usage. Miswak toothpaste exhibited a comparable impact on Lactobacilli, however Streptococcus mutans demonstrated a notable decrease alone after two weeks of use. Standard paste exhibited negligible effects on both bacteria at both time intervals, however the incorporation of normal saline shown substantial impacts on both bacteria alone after two weeks of application [5].

The findings of a study that was carried out by Heba J. Sabbagh et al. on students between the ages of 8 and 10 years revealed a statistically significant reduction in the average plaque score during the course of the study (P = 0.007 and P = 0.001) throughout each of the study groups. Ervina Diah Ruslinawati, et al. (2015) did research on primary school pupils totaling 228 persons using the concept of comparative analytical research, with a cross sectional approach. The findings of this study are consistent with the findings of that research. Data gathering methods that involve the direct examination of the sample population. The research demonstrated that using toothpaste that contained miswak extract to brush one's teeth had an effect on lowering the amount of plaque that was found on one's teeth. Before brushing teeth with toothpaste that contained miswak extract, the average dental plaque score varied from 1.2 to 3.6, with an average plaque index of 2.18. After brushing teeth, the average dental plaque score ranged from 0.2 to 0.8, with an average plaque index of 0.48 [6].

A study by Taufan Bramantoro et al. on the Santri of As-Salafi Al Fitrah Islamic Boarding School, who regularly utilize miswak, employed semi-open and closed questionnaire methods. The results were analyzed using XLstat 2017 software. Data are presented in tabular format, with descriptive analysis expressed as percentages and odds ratios (OR). Linear regression was employed to conduct multivariate analysis. The findings indicated that perceived behavioral control exerted the most significant impact on enhancing intention, with $\beta=0.211$ and $p<0.05$. Conversely, attitude and subjective norm exerted a lesser impact on enhancing intention, with $\beta=0.190$ and $p>0.05$, and $\beta=0.164$ and $p<0.0001$, respectively. Perceived behavioral control shown a direct association with action in the model parameters, with $\beta=0.445$ and $p<0.0001$. This study demonstrated that miswak (*Salvadora persica*) offers multiple advantages for oral health, including antibacterial properties and superior efficacy compared to conventional toothbrushes. It can be utilized to enhance the functionality of toothbrushes, as endorsed by Islamic religious guidelines, or employed independently to promote oral health through a religious framework [7].

Miswak is the most effective preventive measure against dental caries for both children and adults because to its fluoride content. Miswak (*Salvadora persica*) possesses potent chemicals, particularly sulfur-containing ones. This chemical can adhere to the mucosa, teeth, oral cavity, and gums for several hours. This chemical acts as a natural antibiotic that inhibits the proliferation of harmful oral bacteria [9].

5. Conclusion

According to the findings of previous studies, the usage of toothpaste that contains miswak (*Salvadora persica*) has the potential to have an effect in avoiding the production of dental plaque and caries. More specifically, that toothpaste can reduce the dental plaque index, which in turn helps to prevent caries. The reason for this is because miswak possesses antifungal, antibacterial, and anti-caries qualities, which have the ability to inhibit the growth of microorganisms that are responsible for maintaining dental plaque and caries.

Compliance with ethical standards

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Disclosure of conflict of interest

All the authors declare that there is not any conflict of interest with this document's release

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