

*Review*

# **Miswak: The underutilized device and future challenges**

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There have been many studies on the practice of maintaining dental health. Although most people currently use a toothbrush to maintain the cleanliness of mouth, specific populations still used *miswak* as an alternative tool for oral health care. This study was designed to answer the future challenges of use of *miswak* as a tool to maintain oral health according to modern sciences. The history, features, function, modernization, and method in *miswak* were discussed in this article. The effect of *miswak* on periodontal health and antimicrobial has also been explained thoroughly in this article. Thus, *miswak* can be said to be a natural source of material that has many benefits in the improvement of oral health. The *miswak* extract has been modified and added in toothpaste, mouthwash, endodontic irrigation treatment, and for testing DNA. The *miswak* is used widely as a tool for brushing teeth and is like or better than a standard toothbrush.

**Key words:** *Miswak*, *Salvadora persica*, chewing stick, *siwak*

## **INTRODUCTION**

The use of sticks from the *Salvadora persica* plant to clean the teeth and mouth is widely known in traditional Arabic culture. This stick is known as *Miswak* or *Siwak*. The *miswak* in Arabic means "stick to brush your teeth" (Hattab, 1997; Arora and Gupta, 2011). Since around seven thousand years ago, the Babylonians have used *miswak* as a tool in cleaning the teeth. This habit was later followed by countries, such as Greece, Rome, Jews, Egypt, and the Islamic kingdom. Some countries in Africa, South America, Asia, and the Middle East countries such as Saudi Arabia and all other Islamic countries are known to use *miswak* until now (Chaurasia et al., 2013). However, the well-known benefits of *miswak*

and its use have been recommended by the World Health Organization (WHO, 1987), which is a body in charge of health issues around the globe (Ahmad and Ahamed, 2012). Recently, *miswak* has been comprehensively reviewed (Ra'ed et al., 1999; Wu et al. 2001; Ahmad and Ahamed, 2012) along with its effectiveness as one of the tools to maintain oral hygiene (FDI, 2000; Ahmad and Ahamed, 2012) where it has been found as effectively and exclusively capable of replacing the toothbrush. However, it was suggested for *miswak* users to support planning to strengthen the evidence of the current trial, especially in developing countries where oral health care services are limited for ordinary people (Aeeza et

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al., 2016) The *miswak* made from *S. persica* has been found to contain several medicinal properties, in which almost all parts have an essential role in the pharmaceutical field (Almas, 2002; Almas et al., 2005; Darmani et al., 2006; Arora and Gupta, 2011). Several studies have reported the effectiveness of the use of *miswak*. The clinical experimental study has been conducted at the Institute of Odontology, Karolinska Institute. They concluded that *miswak* is as effective as conventional toothbrushes in reducing plaque (Batwa et al., 2006), showing that *miswak* can effectively and exclusively replace the toothbrush (Aeeza et al., 2016).

Based on this description, the persons can obtain many advantages from the use of *miswak*. Although many people have abandoned using it because they prefer to use a toothbrush as a tool to maintain their oral hygiene, *miswak* is still used by certain people in the world, especially among Muslims. Therefore, the review of this study is designed to answer the future challenges of using *miswak* as a tool to maintain oral health following modern science.

### **Miswak (chewing stick)**

*Miswak* usually made from roots, twigs, and stems of *S. persica* plants is used to make chewing sticks (Haque, 2015). *S. persica* is a small plant or shrub with twisted stems. The stems and roots of the plant are spongy and between the teeth can smash easily. Root cutting is usually flavorful and softened when immersed in water (Almas and Al-Zied, 2004). The bark is light brown, while the inside surface is white. It smells like crescents as well as taste warm and pungent (Ragail et al., 2017). *S. persica* contains proven medicinal properties and has found an important role in the pharmaceutical field in almost all parts (Almas, 2002; Almas et al., 2005; Darmani et al., 2006); Arora and Gupta, 2011).

*Miswak* wood trees are generally still found in East India, Chad, Saudi Arabia, Egypt, southern Sudan, and Pakistan. This stick is famous in all Muslim countries and well known throughout the Indian subcontinent. As mentioned before, *miswak* has been used by the Babylonians since around seven thousand years ago and later, followed by other nations such as Jews, Greeks, Romans, Egyptians, and Islamic kingdoms. Currently, many have used *miswak*, especially in South America, the Middle East, including Saudi Arabia, Asia, Africa, and all Islamic countries (Chaurasia et al., 2013). This matter is due to its easy to use and has low price, making it a tool to prevent highly effective plaques in various communities (Bos, 1993; Darout et al., 2000; Wu et al., 2001; Hyson, 2003; Ahmad and Ahamed, 2012).

Chewed wood has various names as it is called *siwak* and *miswak* in the Middle East. Meanwhile, in India and Pakistan it is usually called *Datun*, in Ethiopia it is called

*Mefaka* and in Tanzania *Mswaki*, respectively (Ra'ed et al., 1999). In Nusantara, this *miswak* is famous for its name been called sugi wood (Fatin et al., 2012). The most common source of *miswak* is *S. persica* (Almas and Al-Zied, 2004), which has many other names, like *Salvadora indica*, *Mustard tree*, *Peelu*, *Pilu*, *Galenia Asiatica*, *Meswak*, *Arak* or natural toothbrush trees all synonymous of *S. persica*. Besides, *miswak* belongs to the *Salvadora* species and the *Salvadoraceae* family (Chaurasia et al., 2013). Countries in the Middle East are famous for using *S. persica*. It is believed that Prophet Muhammad used this plant, hence Muslim commentators stated that the Prophet's narrative of *miswak* rods from the *S. persica* tree, thus highly recommended it as the most suitable tree for making *miswak* (Ibn Qayyim, 2003; Fatin et al., 2012).

### **Features of miswak**

*Miswak* is in the form of small stems, like pencils with a length of 15-20 cm in diameter ranging from 1-1.5 cm and made from roots, stems, twigs or bark of a particular tree or bush (Almas and Al lafi, 1995). This stick is called a chewing stick due to its structure. It is a very suitable size, plus having a taste like mint on it makes it fun for one to chew. Sometimes a small portion of a stick is used as a toothpick (Ezoddini-Ardakani, 2009). From one end of the chewing stick, it needs to be sharpened or chewed until it becomes fibers, like brushes (Almas and Al lafi, 1995).

Soaking the *miswak* for a few hours in water will make the fibers softer, and easier to separate when tapering or chewing. Brief chewing will only form the fiber prior to being used as a toothbrush, before proceeding to the oral cleansing, which includes brushing your teeth, gums, and tongue. After finished, the chewing stick is removed from the mouth or can let for some additional time in the mouth. This matter is because if it is in the mouth, *miswak* can stimulate saliva discharge for the cleansing effect to be better. However, when It does not use *miswak*, it should be advisable to be stored in a humid place (Almas and Al lafi, 1995). After several times, the *miswak* can replace with a new one or the fur can be cut to obtain a new tip where the new feather is obtained by chewing it again (Wu et al., 2001).

### **Miswak as oral hygiene device**

Recently, *miswak* has been comprehensively reviewed (Ra'ed et al., 1999; Wu et al., 2001; Ahmad and Ahamed, 2012) and found to be useful as one of the tools to maintain oral hygiene (FDI, 2000; Ahmad and Ahamed, 2012). Hassan et al. (2011) conducted detailed surveys in various regions of Saudi Arabia and concluded that *S.*

*persica* can be used for dental treatment, anti-ulcer, and has anti-inflammatory properties. On the other hand, Olsson (1978) assessed the effectiveness of *miswak* users and found that it was the same as *miswak* plus toothbrush users on oral hygiene. However, there is no valid population data regarding the effects of *miswak* uses on periodontal health. Although, Darout et al. (2000) reported that the Sudanese population has a better periodontal status for *miswak* users compared to those who use toothbrushes to clean their teeth, this study shows that the use of *miswak* is efficient. That is comparable or slightly better for oral health (Ahmad and Ahamed, 2012). Since then, subsequent studies have concluded that using *miswak* is best in dental prevention programs as it is economical and familiar to parents (Ra'ed et al., 1999).

### Use of *miswak*

There are few factors that need to be considered in using *miswak* in order to get the optimum effect in cleaning the teeth and mouth. Many researchers found that the time of using *miswak*, cutting the tip of *miswak* every time after use, and the techniques that are used by the person affect the efficiency of the *miswak*.

Before the use of *miswak*, the tip meant for brushing must be washed with water (Almas and Al lafi, 1995). After that, one end of the *miswak* that will be used should be immersed in water for a few minutes (between 2 and 5 min) before using it. Some scholars suggested that for the first use, the person should soak the tip of the *miswak* for several hours, likely about 24 h. However, if the person soaks it for too long, the chemical content will dissolve in the water. This matter will reduce the usefulness, although the mechanical function would still be as usual (Al-Din et al., 1988; Ramli et al., 2017). Afterward, one end of the *miswak* should be chewed until fibrous like feathers appear to form a toothbrush. It is also recommended to bite *miswak* evenly throughout the teeth surface from right to left. As such, it can be a benefit to clean the occlusal surface of teeth (Ramli et al., 2017).

To get the maximum effect, it should be ensured that the tip of the *miswak* is always fresh. For this reason, it is necessary to cut the tip of the *miswak* every time it will be used as *miswak* will release several benzyl isothiocyanate when using it in the mouth. The several times use on the same end piece causes a reduction in the amount of benzyl isothiocyanate which is released gradually (Albaptain et al., 2017).

Although the Qur'an and Hadith do not mention a proper procedure for brushing teeth using *miswak*, some scholars have stated ways to clean the teeth using *miswak*. Almas and Al lafi (1995) said the two basic techniques of holding *miswak* are; five-finger grip and a three-finger grip. According to them, these can ensure a

substantial movement from the tip of the *miswak* brush in the mouth and can get to any part of the oral cavity with relative ease. Just like using a toothbrush, using *miswak* to mechanically clean plaque can be done through vertical and horizontal movements. On the buccal and labial surfaces, this cleansing movement must be from the gingival margin of the tooth towards the incisal/occlusal teeth. Meanwhile on the occlusal surface, it can employ scrubbing movements from anterior to posterior (Almas and Al lafi, 1995).

Hirschfeld (1987) proposed the following procedure: must hold the *miswak* with the four fingers (index, middle, ring, and little finger respectively). While placing the thumb along the stem of the *miswak* towards the feathers, brushing starts from the front teeth, then follows the buccal and lingual/palatal surfaces of the back teeth while the chewing surface is the last (Aboul-Enein, 2013).

Ramli et al. (2017) wrote in a book entitled "Rahsia *siwak* dalam Sunah dan sains *pergigian*" about how to use *miswak* and proposed that the *miswak* stem can be held in various ways, viz; five finger grip, three finger grips, pen grasp or two fingers lower, and three fingers above. Brushing teeth using *miswak* is a horizontal movement of 5 to 10 times in 2 to 3 teeth at once. This horizontal movement is mainly for molar surfaces and palatal premolars, whereas for palatal teeth and incisors, the motions are vertical. The occlusal surface is brushed with forward and backward horizontal movements, while the whole action always starts from the right.

### Modernization of *miswak* in oral health care

Contemporarily, *miswak* is being sold in the market with a variety of packaging that looks cleaner and healthier. It is therefore known to have some amount of chemical content in *S. persica*. Currently, with the development of the era, *S. persica* is not only being used as a toothbrush but also as toothpaste (Haque, 2015); mouthwash (Mustafa et al., 1987); endodontic irrigation solution (Al-Salman et al., 2005; Sukkarwalla et al., 2013); determination of DNA profiling (Alfadaly et al., 2016) and tooth whitening (Halib et al., 2017).

Hattab (1997) said that toothpaste with ingredients containing *S. persica miswak* extract was more effective than Oral-B toothpaste in removing dental plaque. The samples product content of *miswak* to toothpaste in the market are: English (Sarkan toothpaste), Switzerland (Quali-Meswak toothpaste), Egypt (Epident toothpaste), Pakistan (Fluoroswak and *Miswak* toothpaste), Saudi Arabia (Dentacare *Miswak* Plus toothpaste) and Indonesia (Siwak toothpaste) (Ra'ed et al., 1999).

According to Mustafa et al. (1987), the formation of plaque will reduce when rinsing with mouthwash based on *miswak* (Ra'ed et al., 1999). However, Fouad Hussein et al. (2010), in clinical trials, concluded that *S. persica*

extract at a concentration of 10 mg/ml was well tolerated and safe, thereby resulting in excellent antibacterial activity *in vitro*. As a mouthwash, *S. persica* extract is less effective than chlorhexidine in preventing the accumulation of dental plaque, but it is more effective than the placebo. The samples product that content *S. persica* of mouthwash are: Siwak-F mouthwash and *Miswak* mouthwash.

There have not been any scientific reports about the use of *miswak* extract for irrigation in root canal treatment (Ra'ed et al., 1999). However, Al-Salman et al. (2005) and Al-Sabawi et al. (2007) reported *miswak* as adequate for root canal irrigation because it limits levels of aerobic and anaerobic bacteria during root canal treatment (Sukkarwalla et al., 2013). Also, Al-Sabawi et al. (2007) reported investigation of the efficacy of *miswak* as root canal irrigation through a method of comparing the effects of flooding containing *miswak* with other root canal irrigation. As such, 15% of *miswak* extract has been found to have properties similar to chlorhexidine 0.2%, which is very useful for both aerobic and anaerobic bacteria in the necrotic pulp. Besides, *miswak* extract and *chlorhexidine*, *sodium hypochlorite* has also shown the highest anti-microbial effect (Sukkarwalla et al., 2013).

Lastly, *miswak* contains enough DNA to produce a good DNA profile successfully. Therefore, when compared to a toothbrush, *miswak* is a source of DNA profiles that can be used to aid forensic identification. It also can be used as a source of identification even after months of usage because up to four months' storage time has little or no effect on results (Alfadaly et al., (2016).

In another study, researchers found crystal in *miswak* using Energy-Dispersive X-ray spectroscopy technique. This crystal can act as a natural abrasive. They suggested that the paste from *S. persica* can be used as an alternative material for teeth whitening that can remove extrinsic staining (Halib et al., 2017).

## EFFECT OF MISWAK ON PERIODONTAL HEALTH

Many studies have proven that the use of *miswak* has effects on the health of periodontal tissue, such as antiplaque, gingival recession, periodontal pocket depth and gingival bleeding.

### Antiplaque

There have been several studies on the effectiveness of using *miswak*. A cross-sectional survey on adults conducted in Ghana shows the opposite results, where it found that there are more plaque and gingival bleeding in *miswak* users than toothbrush users. However, there is no difference, as observed in children aged 7-15 years in Tanzania (Almas and Al lafi, 1995; Ra'ed et al., 1999). In

another trial with the children in Ethiopia and adolescents in Nigeria, *miswak* appears to be as effective as a toothbrush in removing plaque (Olsson, 1978; Almas and Al lafi, 1995). The results of these studies suggested that teaching and controlling are fundamental as it finds a sample of children that were not familiar with the technique of using *miswak*. As such, it can be concluded that the maintenance of poor oral hygiene in people who use *miswak* reflects the inferior method of using *miswak* (Ra'ed et al., 1999).

Danielson et al. (1989) stated that the reduction of front tooth plaque is better than posterior teeth in *miswak* users, hence it is recommended for maintaining oral hygiene. Mustafa et al. (1987) derived a 75% reduction in plaque after eight days of *miswak* usage while Gazi et al. (1990) reported that there was a significant reduction in plaque and gum inflammation when using *miswak* five times a day compared to the use of a conventional toothbrush (Ra'ed et al., 1999).

Conversely, a clinical experimental study conducted at the Institute of Odontology, Karolinska Institute, concluded that *miswak* is as effective as a traditional toothbrush in reducing plaque (Batwa et al., 2006). Also, randomized clinical trials among dentistry students from Dow University of Health Sciences, Karachi, Pakistan revealed that *miswak* has a mechanical and chemical cleansing in the mouth that is stronger than a toothbrush. As such, it has discovered a significant efficacy of antiplaque in the use of *miswak*. This matter shows that *miswak* can effectively and exclusively replace toothbrush (Aeeza et al., 2016).

### Gingival recession

The gingival recession, also known as shrinking gum, is exposure to the tooth root resulting from loss of gum tissue or marginal gingival retraction of the dental crown. The high level of gingival recession and tooth abrasion is associated with the use of *miswak* (Dahiya et al., 2012). In Saudi, schoolchildren show the relationship between excessive *miswak* usage and gingival recession (Younes and El-Angbawi, 1983; Halawany, 2012). It was reported that there was relatively high prevalence of gingival recession in Tanzania in the adult population, and that gingival recession on the lingual and buccal surface has the same level (Van Palenstein et al., 1992; Ra'ed et al., 1999). Meanwhile, Eid et al. (1991) reported many cases of gingival recession in *miswak* users, which may be due to mechanical trauma (Halawany, 2012).

### Periodontal pocket depth and gingival bleeding

Sote (1987) found no difference in gingival bleeding, plaque, and on *miswak* and toothbrush users. Similarly,

Eid et al. (1990a) also reported that among users of *miswak* and modern toothbrush users, there were no significant differences in the gingival index or bleeding score. However, Gazi et al. (1990) stated that the comparison of periodontal status between *miswak* users and conventional toothbrushes showed that *miswak* users had lower gingival bleeding and high interproximal bone compared to toothbrush users (Dahiya et al., 2012). Sofrata (2010) reported that *miswak* users had the same pocket depth as toothbrush users in Saudi Arabia whereas *miswak* users had deeper pockets on midfacial surfaces than toothbrush users (Almas and Al lafi, 1995). Still, Darout et al. (2000) conducted a study on 213 men of the Sudanese nation, where they evaluated periodontal conditions for *miswak* users compared to toothbrush users and concluded that Sudanese people who used *miswak* to maintain their oral hygiene had better periodontal status than those who used toothbrush.

#### ANTIMICROBIAL EFFECT OF MISWAK

Many studies have reported that *S. persica* contains antiplaque and antibacterial substances against certain types of cariogenic bacteria in the oral cavity. Materials contained in *S. persica* can inhibit the growth and production of acidic bacteria (Abo Al-Samh, 1996; Almas et al., 1997; Ra'ed et al., 1999). A study was conducted by Al-Mas and Al-Zeid (2004) to compare the presence of *Streptococcus mutants* and *lactobacilli* bacteria in saliva between the toothbrush and *miswak* users. The results showed that the number of *S. mutants* in saliva decreased significantly, but there was no significant difference in *lactobacilli* bacteria (Almas and Al-Zied, 2004; Fatin et al., 2012). Similarly, Wolinsky et al. (1996) also showed that *S. persica* reduced the strength of specific colonization of *Streptococci* on tooth surfaces (Ezoddini-Ardakani et al., 2012).

Again, Al-Lafi and Ababneh (1995) reported that using *miswak* can prevent chemical plaque formation. Besides that, *miswak* also has antimicrobial effects on several types of microorganisms. Al-Otaibi et al. (2004) observed comparisons of *miswak* and toothbrush users and found a significant reduction on the amount of *Actinomycetemcomitans aggregatibacter* in subgingival subagents. Also, it showed that the extracts of *S. persica* could damage the growth and leukotoxicity processes against bacteria *A. actinomycetemcomitans* (Dahiya et al., 2012).

Further, Sofrata et al. (2008) studied the effects of fragments of *miswak* on bacteria in periodontitis as well as tooth decay, concluding that the most prominent antibacterial effects are in *A. actinomycetemcomitans*, *Porphyromonas gingivalis*, and *Haemophilus influenza*. The impact on *S. mutants* is less while the least effect is on the *Lactobacillus acidophilus* bacteria.

#### CONCLUSION

Various studies have proven that the use of *miswak* as a tool for maintaining dental and oral hygiene has the benefit of being antiplaque. Thus, it can prevent dental caries and periodontal problems.

Furthermore, with the presence of modern toothbrushes, the *miswak* is marginalized, but researches have introduced variations in the use of *miswak*, such as packaging to make it more beautiful and healthier. Additionally, some form of *miswak* has also been modernized like a mechanical pencil.

Although many studies have shown that using *miswak* has a good effect on oral health, however, they must do further research on the technique of using *miswak*. Also, as a natural material, various innovations have been carried out at this time to maximize its benefits. Thus, to obtain the maximum result, future research must be emphasized through interventions to explore the other benefits of *miswak*.

#### CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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