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 use 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
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 (Ragaii 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 Salvador indica, Mustard tree, Peelu, Pilu, Galenia Asiatica, Meswak, Arak or natural toothbrush trees all synonymous of S. persica. Besides, miswak belongs to the Salvadoraceae 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 Iifi, 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 Iifi, 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 Iifi, 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.


**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 Iafi, 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 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 benzyll isothiocyanate when using it in the mouth. The several times use on the same end piece causes a reduction in the amount of benzyll isothiocyanate which is released gradually (Allabtaitain 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 Iafi (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 Iafi, 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 investigated 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 toothbrush users 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 anti-plaque 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 mutans* and lactobacilli bacteria in saliva between the toothbrush and miswak users. The results showed that the number of *S. mutans* 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 *Streptococi* on tooth surfaces (Ezzoddini-Arndakani 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. mutans* 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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