MISWAK (SALVADORA PERSICA CHEWING STICK) AND ITS ROLE IN ORAL HEALTH; AN UPDATE

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ABSTRACT: Miswak, as a cultural and scientific heritage oral hygiene tool, it is now being evaluated on evidence-based criteria. Through comparing the naturally-occurring and scientific evolution of Salvadora persica’s usage, we will be able to better understand the uniqueness of miswak, relative to that of other oral hygiene tools as being a solo oral hygiene tool of a significant part of the World population. The review is an update on chemical composition, antimicrobial, anticariogenic, anti plaque, and antigingivitis effects of miswak on oral health in the context of invitro experiments and clinical trials. Special emphasize is on how to use and when to use miswak for effective cleaning of teeth and mouth. Recent scientific evidence regarding its probiotic role, cell viability and comparative cytotoxicity and research trends will be highlighted.

It is hoped that the review will help health care professionals to have better knowledge and awareness about miswak, to improve the quality of life of their culturally diverse patients population who are uninitiated for regular oral hygiene measures due to various constraints. The use of miswak on population bases is in line with the theme of primary health care approach (PHCA) and oral health promotion. Miswak has wider acceptance among many communities and populations around the world.

KEY WORDS: Miswak, Chewing stick, Salvadora persica, natural tooth brush, oral hygiene.


INTRODUCTION

A healthy mouth leads to a healthy body. Good oral hygiene is the key to good oral and systemic health. Acceptable level of plaque control, from where periodontal disease cannot be initiated or progressed is the ultimate desire of oral and dental professionals. The body-mouth relationship is of great interest among health care professionals. With the increasing prevalence of oral and dental diseases, the international need for preventive and curative methods has been surfaced. Not only are alternate preventive and treatment methods being expanded but also safe, effective, economical and culture based traditional remedies and products are being explored. A tooth brush and tooth pastes are commonly used in developed and developing countries for cleaning teeth. Miswak (chewing sticks) has its unique role in oral hygiene and maintenance of oral health.

MISWAK IN A HISTORICAL PERSPECTIVE

The evolutionary development of the modern day toothbrush may be traced to chewing sticks that were used by the Babylonians. The use of chewing stick was recorded by the Babylonians in 5,000 BC and the fashion rapidly spread throughout the Greek and Roman empires. The chewing stick was also used by the Egyptians, the Jews, and among the Muslim world. References to the use of chewing stick can be found in the Talmud, as the Quesum, the Siwak, Miswak and Arak. Its use as a chewing stick or Siwak was documented in the Arabian Muwasha written by Alwashah, in AD 900. It is believed that the modern day tooth brush was not known in Europe until about 300 years ago, Lewis and Lewis (1). Medical texts of ancient India, Susruta Samhita and Charaka Samhita, have also emphasized on oral hygiene and brushing teeth with herbal sticks (2). Today miswak is being used in different parts of the world. Chewing sticks are known by various names including the word

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“miswak” or “arak” in Arabic, “qesam in Hebrew, “qisa” in Aramaic, “koyoi” in Japanese, “mastic” in Latin (3) and “mefaka” in Ethiopia (4) and datun in Pakistan and India (5).

In many Middle Eastern, Asian, and African American communities, traditional methods of tooth cleaning are still used due to low cost, affordability, availability, usage in rituals, and to serve custom, and religious purposes (6). Chewing sticks have various other uses such as: using them as jaw exercisers, inducing a reflex of copious saliva secretion, combating undesirable oral habits including smoking and thumb-sucking, and lastly, they can also be used during the teething process (7). In terms of geographical distribution, S. persica usage is widely spread and ranges from countries such as Malaysia, Nepal and India in the East through Iran, Iraq, Pakistan, Saudi Arabia, and Egypt to Mauritania in the West, from North Africa and Central Africa to Southwestern Africa (8).

In the Middle East, Arak (Salvadora persica) is the most common chewing stick. Additionally, the roots of African laburnum (C. siberianba) are used in Sierra Leone and Neem (A. indica) is primarily common in the Indian subcontinent. Other forms of chewing sticks can be found in Western Africa, where the lime tree (C. aurantafolia) and the orange tree (C. sinensis) are utilized for oral health purposes. Not only are miswak used for oral hygiene, they are also related to religious rituals and social purposes (9).

One hundred and eighty-two kinds of plants/shrubs have been used as chewing sticks, throughout the developing world; the most significant is Arak, Salvadora persica (10). The roots, twigs, and stems are the specific parts of the plant that provide dental hygiene (11).

The miswak is a small, upright evergreen tree or shrub with white branches and aromatic roots, rarely ever more than three meters in height and 30 cm in diameter (12). The fresh leaves on the S. persica can be utilized in traditional medicine for treating cough, asthma, scurvy, and other diseases, whereas, the flowers of the tree are used as a stimulant and are mildly purgative (9). Stems and roots of the S. persica are spongy, thus they can be easily chewed and crushed between the teeth. The chewing stick becomes quite spongy after it is soaked in water; therefore, it is highly unlikely to traumatize the gums, if used properly, while brushing (7). The stem or root is chewed on one end, until it becomes frayed and looks similar to the head of a toothbrush (9).

Considering the historical, cultural and religious importance of S. persica miswak as an oral hygiene and maintenance tool, this current review is an update on recent developments in miswak research. Major emphasize is on chemical composition, how to use and when to use miswak for effective cleaning of teeth and mouth. Recent scientific evidence regarding its probiotic role, cell viability and comparative cytotoxicity and research trends are highlighted.

**CHEMICAL COMPOSITION**

The advantageous effects of miswak, in terms of oral hygiene maintenance and dental health, can be attributed to the mechanical role of brushing and its pharmacological component (9). Chemical analysis shows that miswak contains numerous, natural constituents that are known to benefit oral health. The chemical substances present in S. persica are as follows: chloride, fluoride, saponins, salvadoreine, silica, sulfur, sterols, trimethylamine, and vitamin C (7). Another chemical investigation demonstrates the following compounds present in the S. persica plant: β-sitostrol and m-anisic acid chlorides, salvadore, and gypsum; organic compounds, including pyrroline, pyrrole, and piperidine derivatives; glycosides, such as salvadose and salvadoradose; and flavonoids, including karpferol, querceting rutin, and a quercerigen glucoside (13). The main constituent of the Salvadora persica root oil is Benzyl- isothiocyanate (BITC) (14). This component of the Salvadora persica root, Benzyl- isothiocyanate, exhibits broad-spectrum bactericidal activity (15) and inhibits the growth and acid production of Streptmutans (16). According to Chawla (17), chewing sticks like Neem (A. indica), S. persica, A. arabica contain a noticeable amount of fluoride (79).

Many of Salvadora persica’s constituents cited above, aid in the prevention of decay and benefits to preserve the human dentition if utilized properly. The silica present in chewing sticks acts as an abrasive material to reduce stains and whiten teeth. Both the sulfur compounds and alkaloid (salvadoreine) present in S. persica have a bactericidal role but, only salvadoreine exerts a stimulatory action on the gingival (9). The tannins and resins give protection against caries by forming a layer over the enamel due to the astringent
effect on the mucous membrane. Chewing sticks obtained from plants similar to Aegles marmelos, S. persica, A. indica, and Fagara zantholoxoids contain essential oils that exert analgesic, antiseptic, and carminative action. Strong anti-inflammatory action on the gums is provided by substance present in other plants, including Alnus glutinosa, Antidesma venosum, and A. indica (7). Lastly, due to the high concentrations of chloride present in S. persica miswak, calculus formation is inhibited (9). Also, since miswak is used regularly and for a longer period of time, severe calculus buildup does not occur.

**THE PREPARATION OF A MISWAK**

The recommended method for preparing a usable chewing stick is discussed by Almas and Al-Lafi (5). A chewing stick is a piece of wood, usually from the stem of a plant that has an average length of fifteen centimeters and a diameter of one centimeter. Though chewing sticks are sold in several different lengths and diameters, it is important to adjust both the length and the diameter according to the general user. A length of twenty centimeters for adult use and fifteen centimeters for children/minors are the size values recommended for convenience and to insure safe and proper use of the miswak. They also provided a brief anatomical description of the phloem, fibers, and wood of the S. persica plant. There is a large amount of phloem in the S. persica, as well as, widely spaced, think-walled fibers. The spongy wood can be easily crushed by the teeth and softened so that the miswak is chewable without any difficulty.

The first step is to prepare a chewing stick that is freshly cut so that they are supple and still possess all of their active constituents. The reason being, that a very dry chewing stick can damage the gums surrounding the teeth in the oral cavity. It is vital to remember that if a stick is originally dry, it should be soaked in fresh water for twenty-four hours. If the stick is immersed in water for a longer period, it can cause the loss of active ingredients present in the chewing stick, and can even diminish the therapeutic properties the stick possesses. Next, in order to create bristle-like structures on the chewing stick, one side of it should be chewed on for few seconds, until the fibers stand out similar to individual bristles of a regular toothbrush (Fig 1.) After having been used for several instances, the chewing stick is either replaced by a new one or a fresh end is formed by cutting off the old bristles, and creating new ones by chewing and tapering it. It is recommended that the chewing stick should be kept at a moist place when not in use. It should be washed/rinsed with water before using it again (7).

**TECHNIQUES OF USING A MISWAK**

Almas and Al-Lafi (7), gave an account of the mechanical techniques employed for removing plaque using a toothbrush and a miswak are analogous. Vertical and horizontal brushing is important, however, the manual dexterity of individuals, their attitude towards and knowledge of oral health is the critical basis needed to maintain proper oral cleanliness. The chewing stick resembles to the toothbrush as both have bristles and are utilized to remove biofilm/plaque from the tooth surfaces mechanically. However, the chewing stick also have a chemical role and may be chewed or sucked for many hours daily by some people.

A length of 15 cm for children and 20 cm for adults is highly recommended for convenient grip and ease of manipulation. A diameter of 1 cm makes for suppleness and sufficient firmness (7).

Two basic holds have been described in order to have a firm, well controlled movement of the brush-end of the chewing stick in mouth is achieved and that every part of oral cavity is reached with relative convenience. They are described below (8);

- Five fingers grip (shown in figure 2)
  - The four fingers of one hand are curled lightly found the stick, with the index finger nearest the end to be chewed.
  - The pulp of the thumb rests firmly on the opposite
side of the stick to the index finger, the thumb is thus in a higher position than the index finger. The thumb controls the movement of the stick and retains it in a firm grip. All tooth surfaces are accessible if the wrist or arm is moved as needed.

- Three fingers grip (shown in figures 3 & 4)
  - The chewing stick is placed between the index and third fingers. The operative end of the stick is pointed upwards when the hand is in the supine position.
  - The fourth and fifth fingers are kept clenched on the palm.
  - The thumb rests on the side opposite the index the third fingers, where it assumes the dominant role and position.

Tongue is another part of the oral cavity that needs to be cleaned to maintain proper oral hygiene. The tongue is considered to be the cause of bad breath/halitosis if there is a buildup of a white coating on the dorsum of the tongue. Likewise to cleaning teeth with it, the miswak is very effective against cleaning the surface of the tongue in two ways. The bristle end of the miswak can be used, however, for best possible outcome, the sticks can be broken into a V-shaped manner and the resulting blade can be used to scrape several times across the tongue, posterio-anteriorly. The miswak is not only a natural toothbrush; it can also become a makeshift natural tongue scraper for achieving good oral hygiene (7).

**WHEN TO USE THE MISWAK**

Unlike the toothbrush, that is usually allotted a specific time-morning, afternoon, or night, to be used- miswak can be used at various different times throughout
the day. For instance, many people use miswak in public places, while conversing, before breakfast, before going to bed, before praying, and so on (7). Ideally, the chewing stick should be used before meals or immediately after meals so that the bacteria that convert sugar into acid can be removed. However, it was found that the use of miswak after meals is not practical, since the drop in pH and the associated damage takes place within a few minutes, and after twenty minutes, the saliva executes the buffering role. In general, the use of miswak, five times a day, is recommended for all benefits of the naturally occurring effects to take place. To the Muslim, the use of chewing stick is an important part of ablutions before worship which takes place five times daily. The regular use of chewing stick conforms with the theme of primary health care and has long been established practice with certain cultural and religious beliefs and norms (7).

EFFECTS OF MISWAK ON ORAL HEALTH

Antimicrobial effects

Some invitro studies exemplified that S. persica extracts inhibited the growth of various oral aerobic and anaerobic bacteria (6). In an invitro study by Almas (15), the antimicrobial effects of the aqueous extract belonging to seven different types of chewing sticks were compared. The several varying types of chewing stick that were examined included Azadirechta indica, Olea europaea, Acacia Arabica, S. Persica (common name: Peelu and Arak), Gymoscy pentaphylla, and Capparis aphylla. The four microorganisms that were tested consisted of Strept faecalis, Strept mutans, Staph aureus, and C albicans. The aim of the experiment was to find out which microbe was affected by one or more of the chewing sticks and if so, by how much (in mm) was their growth inhibited. It was concluded that there was no effect of any chewing stick on Stept mutans, Staph aureus, and C albicans microorganisms. The aim of the experiment was to find out which microbe was affected by one or more of the chewing sticks and if so, by how much (in mm) was their growth inhibited. It was concluded that there was no effect of any chewing stick on Stept mutans, Staph aureus, and C albicans microorganisms. However, the results also concluded that S. persica (Arak) and Acacia Arabica had significant antimicrobial activity against Strept faecalis at 50% concentration of the miswak extract. The inhibition zone was up to two millimeters for the two chewing sticks.

Another invitro experimental study performed by Almas et al. (19), focused on comparing miswak extract with commercially available mouth rinses. Similarly, there was an experiment to check if there was any antimicrobial activity. Once again, the microbes included were; Strept faecalis, Strept pyogenes, Strept mutans, C albicans, Staph aureus, and Staph epidermis. Mean growth inhibition of the various microbes was recorded (in mm). It was demonstrated that a 50% extract of S. persica miswak was effective against both Strept. mutans and Staph. faecalis. The experiment resulted that there was a seven mm inhibition zone for Strept. faecalis and a three millimeter inhibition zone for Strept. mutans. However, there was no microbial inhibition for the remaining microorganisms.

From the two studies, Almas (18) and Almas et al. (19), it can be concluded that utilizing miswak does in fact, have antimicrobial effects against two types of microorganisms. There is stronger action presented against Streptococcus faecalis as compared to Streptococcus mutans. In the examination of the antimicrobial activity of chewing extracts against different human pathogens, much effort has been expended (6). Though not all dental hygiene tools are helpful in thoroughly inhibiting all pathogens, the reduction of harmful microbial organisms that exist in the oral cavity is still a significant achievement.

Various studies have shown that S. persica contains substances that possess plaque inhibition and antibacterial properties against several types of cariogenic bacteria which are commonly found in the oral cavity. The growth and acid production properties of these bacteria are thus inhibited (20, 21, 22, 23).

AL-Lafi and Ababneh (24) evaluated the antibacterial properties of S. persica against a few oral aerobic and anaerobic bacteria and reported that the extract of these sticks had a drastic effect on the growth of Staph aureus, and a variable effect on other bacterial species. They informed that the chewing sticks used were harvested one month earlier, and suggested that using more fresh sticks will give better and improved results. Almas et al. (23) compared fresh vs. one-month-old miswak extracts for antibacterial activity and found no difference. A comparison of alcohol and aqueous extract of miswak was also evaluated. It was reported that miswak alcoholic extract is more effective than aqueous extract for antibacterial activity (25). A recent study by Almas et al. (26) reported that, the S. persica extract, at a 50% concentration, delayed the growth of Actinomyces naeslundii, Lactobacillus casei, Staph

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aureus, Strept gordonii, Strept mutans, Strept oralis, Strept sanguinis, Veillonella sp. PK1910, F nucleatum and C albicans compared to controls where the extract was replaced by dPBS. 25% extract had a bacteriostatic effect in subset of these species, while 10% extract had no effect. On the contrary, the S. persica extract did not affect the planktonic growth of Lactobacillus fermentum. Killing assays showed that the extract had a partial bactericidal effect on most of the strains tested. The S. persica extract did not affect the viability of C. albicans, S. aureus and L. fermentum. Sofrata et al., (27), reported that the inhibitory effect was most obvious on P. gingivalis, A. actinomycetemcomitans, and H. influenza, comparatively less on S. mutans, and least on L. acidophilus. Suspended miswak pieces had comparable or even stronger effects than the miswak embedded in agar medium.

ANTIFUNGAL ACTIVITY

Al- Bagieh et al. (28) concluded that aqueous extracts of miswak could be used to reduce growth of C. albicans. Such inhibition lasts for up to 36 hours at concentrations of 15% and higher. A recent study by Almas et al. (26) reported that Salvadora persica extract did not affect the viability of C.albicans.

Al-Bayati and Sulaiman (29) compared the aqueous and methanol extracts of S. persica chewing stick for antimicrobial activities against seven isolated oral pathogens (S. aureus, Strept mutans, Strept pyogenes, E. faecalis, L acidophilus, P aeruginosa, and C albicans) using two different methods. Both antimicrobial assays resulted that the aqueous extract inhibited all isolate microorganisms and was more efficient than the methanol extract, which was resisted by L. acidophilus and P. aeruginosa. The most pronounced and strongest antibacterial activity was shown by the aqueous extract against E. faecalis. Turbidity tests exhibited that both extracts had equal antifungal activity against C. albicans. Further research is needed in antymycotic/antifungal effects of miswak.

PROBIOTIC AND PREVENTIVE ROLE OF S. PERSICA MISWAK

Mehanna and Reid (30), studied the effect of miswak extract on oral pathogens and its potential for probiotic use concluded that, miswak had a marked inhibitory effect on the streptococci bacteria and addition of Lactobacillus strains significantly reduced the viable counts of S. mutans. Almas et al. (26) reported that S. persica extract had moderate bactericidal properties against a wide range of oral microorganisms. Interestingly, it did not affect in any way Lactobacillus fermentum, a commonly used probiotic bacterium. The finding has not been observed in any previous studies. The quest in the probiotic role of miswak is in progress and hopefully soon further developments would be part of scientific literature.

ANTIOXIDANT CAPACITY OF MISWAK

There is growing interest in bioactive compounds of S. persica miswak especially antioxidant compounds (31). By definition, antioxidants are substances that when present in foods or body at low concentrations compared with that of an oxidizable substrate markedly delay or prevent the oxidation of that substrate. Various antioxidants included enzymatic antioxidants (e.g., superoxide dismutase, peroxidase, polyphenoloxidase and catalase) and nonenzymatic antioxidants (e.g., ascorbic acid (vitamin C), α-tocopherol (vitamin E), glutathione, carotenoids, and flavonoids) (32). Antioxidants have been considered to help the body to protect itself against various types of oxidative damage caused by reactive oxygen species, which are linked to a variety of diseases including cardiovascular diseases, cancers (33) neurodegenerative diseases, Alzheimer’s disease (34) and inflammatory diseases (35) and some other ailments. The supplement of the diet (or other uses) with antioxidant compounds is one of solutions of this problem that are preserved in natural plant sources (36). These natural plant antioxidants sources can therefore serve their role as a type of preventive medicine. Some investigators suggested that two thirds of the world’s plant species have medicinal value; in particular its considered that many medicinal plants have great antioxidant potential (32).

Mohamed and Khan (31) reported that furan derivatives containing hydroxyl groups could possess antioxidant activities. The antioxidant enzymes were also detected in the chewing stick extract with high level of peroxidase and low level of catalase and polyphenoloxidase. The synergistic actions of antioxidant compounds and antioxidant enzymes make chewing stick as a good tool for cleaning teeth, oral hygiene, oral health and food
purposes.

ANTIPLAQUE, GINGIVAL AND PERIODONTAL HEALTH EFFECTS OF MISWAK

It has been observed, both clinically and experimentally, that *S. persica* chewing stick was as effective and useful as a toothbrush for reducing plaque on buccal tooth surfaces (37). While assessing plaque removal in children from Ethiopia, it was confirmed that the chewing stick appeared to be as effective as the toothbrush, if not more (4). In addition, practicing the proper use of chewing stick as an oral hygiene aid, significantly lower plaque scores in comparison with the use of commonly used toothbrushes (38).

A recent statement on oral hygiene measures (39) concluded that bacterial plaque plays an important role in the etiology of dental caries, gingivitis and periodontitis and effective removal of dental plaque can result in the prevention and or reduction of the above mentioned diseases and conditions (6). As a consequence of plaque reduction, the usage of chewing sticks can also assist in the reduction of gingival inflammation. However, chewing sticks can cause occlusal tooth wear and a small degree of gingival inflammation if used improperly or excessively. Moreover, if a miswak stick is chewed upon in the same area of the mouth, and over a long period of time, it can end up proving to be detrimental instead of beneficial (7). Gingival indices were found significantly lower following the use of *S. persica* chewing sticks in comparison with the use of a commonly used conventional toothbrush without toothpaste (38).

Relatively low number of tooth loss in adults have been reported in countries where miswak is commonly used (10). Epidemiological studies (40,41) emphasized that chewing stick use had beneficial effects on the prevalence and prevention of periodontal diseases and caries. Some other studies reported low periodontal treatment needs among Saudi adults who were regular miswak users (40, 42). An epidemiological study of nomadic population of the Kaisut Desert region of Kenya reported that dental caries and advanced periodontal disease were rare among miswak users under the age of 50 years (43). A retrospective study from Saudi Arabia reported conflicting results about miswak users. They observed deeper periodontal pockets and a higher prevalence of periodontal diseases among miswak users (44) than did non-users. In an institutional study from Sudan (45), showed that the periodontal status of regular miswak users was similar to or slightly better than that of toothbrush users. The above mentioned studies reflect the beneficial use of miswak for the gingival and periodontal health.

CYTOTOXICITY OF MISWAK EXTRACT

The effective role of an ideal antimicrobial agent depends on its ability to kill microbes while causing minimal toxicity to host cells (minimal collateral damage). Rajabalian et al. (46) compared pesica mouthwash and Chlorhexidine mouthwashes on cultured human and mouse cell lines. The cytotoxic effects of four dilutions of Persica and Chlorhexidine mouthwashes on KB, Soas-2, J744 A1, and gingival fibroblast cells were evaluated using MTT assay. The effect of fetal calf serum (FCS) components on the cytotoxicity of these mouthwashes was also evaluated. They found that both Persica and Chlorhexidine mouthwashes were toxic to epithelial, fibroblast, macrophages, and osteoblast cells in concentration-dependent manner.

A recent comparative study by Almas et al. (47), on cytotoxicity of *S. persica* aqueous extract and Chlorhexidine gluconate on L929 mouse fibroblasts obtained from American Type Culture Collection (Manassas, VA, USA). They concluded that the cell viability of miswak extract was 88%, 90%, 97%, 95% in original strength (50%) and 1/2, 1/4, 1/8, 1/16, 1/32 dilutions, while the cell viability of CHX is 3%, 47%, 87%, 93%, 92% and 95% in the corresponding concentrations. Miswak extract had significantly less cytotoxicity than CHX in the original and 1/2, 1/4 dilutions (p=0.05).

Mohammad and Turner (48) tested the cytotoxic potential of the *S. persica* miswak and its diffusible components on oral tissues using the tissue culture agar overlay method. They reported no cytotoxic effect of freshly cut *S. persica* chewing stick, but observed that the same plants contained harmful components if used after 24 hours. A recent study evaluated the role of direct administration of high doses of *S. persica* miswak extract to mice, reported minor side effects on male and female reproductive systems and fertility (49). An earlier study concluded that neither aqueous nor ethanolic *S. persica* miswak extract was toxic to mice, at doses of up to 1200 mg/kg (50).
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Further research is needed to assess the comparative cytotoxic effects of miswak extract and Chlorhexidine to human macrophages, epithelial cells, fibroblasts and osteoblasts. That would help to precisely use miswak extract or chlorhexidine after periodontal or oral surgery procedures.

**MISWAK AS A CULTURAL HERITAGE AND ORAL HEALTH PROMOTION TOOL**

In the early Islamic period, the use of miswak became a part of a cultivated and elegant mode of life and as a prominent feature of Islamic hygienic jurisprudence. Today, cross-cultural knowledge can help motivate public health dentists and dental hygienists to recognize culturally accepted behaviors for the purpose of strengthening patient-provider relationships and optimizing public health outcomes. Such recommendations can offer ways to mix or merge western healthcare with Islamic practices and precepts surrounding the use of miswak and dental hygiene practices considering that healthcare providers and professionals live and work in a global village or society. (51). The French philosopher Auguste Comte (1798-1857) stated, “demography is destiny”. With world populations becoming more culturally diverse, healthcare providers must practice cultural awareness and sensitivities to achieve trust, and to direct the patient-provider relationship toward the desired goal of quality oral health care for all populations. Unfortunately, ignorance of customs can undermine the establishment of trusting relationship. As in the case of the miswak chewing stick; oral health care professionals should review miswak use with their patients to ensure proper and effective use and angulation to achieve maximum bacterial plaque removal. (51-53). Miswak being a cultural and scientific heritage has a lot more to offer to present day oral hygiene needs of many communities around the world.

**CONCLUSION AND RECOMMENDATIONS**

Miswak has been proven effective as an oral hygiene aid and should be introduced and promoted to general population based on scientific rationale. In addition, the use of the miswak conforms to the theme of primary healthcare approach, as well as certain cultural, traditional, social, and religious beliefs and rituals. Incorporating the utilization of miswak into the healthcare system of many developing countries will greatly facilitate the masses with financial constraints, as well as limited oral health care facilities.

Miswak is available in rural areas of developing countries, it does not require special technology to produce. Health care resources are limited in many countries, and there is a growing concern to scientifically research, and test freely available and rel ativel low cost traditional preventive tools in order to improve the healthcare conditions of the world population.

Despite the high initial cost of further investigating the properties of S. persica miswak, it will prove to be economically and financially profitable once the consorted efforts are made. The advantageous effects of miswak usage are undeniable, and it is indisputable that there is a plethora of benefits of utilizing the miswak. Now, the responsibility of healthcare professionals including, medical and dental doctors, hygienists across the globe is to revisit miswak for better oral and systemic health of their respective populations. Certainly that would improve the quality of life of those populations and societies and reduce the oral diseases and financial burden. Countries like Pakistan, could benefit from the culture and religion-based oral hygiene use of miswak both at rural and urban levels. Healthcare professionals should learn more about the recent advances in scientifically proven role of miswak for their respective clientele.

Further research should be conducted to explore probiotic and antioxidant role of miswak. Double blinded, randomized clinical trials (RCTs) comparing clinical parameters of periodontal health and diseases would add into evidence-based scientific credibility and practices of miswak.

**ACKNOWLEDGMENTS**

Authors would like to thank and appreciate the dedicated researchers for their continuous interest in miswak research. I am (KA) pleased to share my twenty years of scientific progress and contributions to miswak (Salvadora persica chewing sticks) literature.
(Appendix; A). It is hoped the review would attract and invite new researchers in the scientific journey of miswak.

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