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# Chewing Sticks In The Era Of Toothbrush: A Review

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## Abstract

There is a long history of the use of plants to improve dental health and promote oral hygiene and is still commonly practiced among Afro-Asian communities. Pencil sized sticks are fashioned from certain plant parts and are chewed on one end until they become frayed into a brush and the brush end is used to clean the teeth in a similar manner to the toothbrush. The plant parts when used in this manner are commonly referred as the "chewing stick". Their use still continues in the modern era of dentistry. It is inexpensive and easily available in rural areas. Further they are used for customary and religious reasons as well. Several studies have demonstrated the anti-plaque, anti carious and antibacterial effect of these sticks. The effect of the chewing sticks and the modern toothbrush and tooth paste on the oral and dental hygiene are reviewed.

## INTRODUCTION

Chewing sticks are commonly used as oral hygiene tool in various parts of the world. The choice of stick depends largely on traditional preference rather than clinical effectiveness. It is an affordable oral hygiene device and additional benefits are derived from its functional aspect of chewing as jaw exerciser as well as reflex induction of saliva which is beneficial to the oral hygiene. The lower incidence of dental caries amongst users of chewing sticks (compared to non-users) has been attributed to the superior mechanical cleansing action on the teeth and to the antimicrobial properties of some of these sticks.<sup>1-3</sup> A review of the efficacy and usefulness of chewing sticks in comparison to the toothbrush and toothpaste in dental hygiene is being presented.

## REVIEW

The use of chewing sticks has been documented since ancient times. This kind of tooth brushing has been used by the Babylonians some 7000 years ago.<sup>4</sup> The use of wood stick for brushing teeth continues to be an important tool in many Afro-Asian communities. It has different names in different societies for instance; miswak, siwak or arak is used in the Middle East, miswaki, in Tanzania, mefaka in Ethiopia and datun in India and Pakistan. The conventional meaning of miswak is stick used to clean teeth and gums. The most commonly used chewing sticks are those having a good flavor, texture and a recognized effect on the teeth and supporting tissue. Freshly cut specimens are always desirable because they are more easily chewed into a brush.

The plants used are very carefully selected for such properties as foaminess, hardness or bitterness and certain species are more popular than others. A great number of these plant species have related medicinal properties that may be antibacterial.<sup>5,6</sup>

## PLANTS COMMONLY USED AS CHEWING STICKS

Popular plants which are fashioned into chewing and/or tooth brushing sticks include *Salvadora persica* (miswak from arak tree) and *Azadirachta indica* (Neem). Some of the popular species used as natural toothbrush in Southern-Eastern Africa are *Albizia coriaria*, *Acacia nilotica*, *Balanites aegyptiaca*, *Berchemia discolor*, *Boscia coriacea*, *Cadaba farinose*, *Cordia sinensis*, *Cupressus lusitanica*, *Dobera glabra*, *Dodonia angustifolia*, *Euclea schimperii*, *Olea europea* subsp. *africana*, *Rhus abyssinica*, *Rhus natalensis*, *Rhus retinorrhoeae*, *Rhamnus staddo*, *Sterospermum kunthianum*, *Salix subserrata*, *Vernonia amygdalina*, etc. In West Africa the lime tree (*Citrus aurantifolia*) and the orange tree (*Citrus sinensis*) are used. The roots of *Senna* (*Cassia vinnea*) were used by black Americans and those of African laburnum (*Cassia sieberiana*) were used in Sierra Leone. Arak, a tree used for miswak, is also known as "tooth brush tree". Although the Miswak is usually obtained from the roots of the Arak tree, some sticks are made from its branches and bark.<sup>7,8</sup>

## INDIAN PLANTS COMMONLY USED AS

## CHEWING STICKS

In India plant wealth is greatly exploited for its therapeutic potential and medicinal efficacy to cure various oral ailments since time immemorial. Neem (*Azadirachta indica*) is widely used to provide chewing sticks in the Indian subcontinent.<sup>8</sup> Tripathi has documented various plants being used in oral health care as chewing sticks (dantun) by the rural population of India. Some plants have been listed in Table-I. These are still used to clean the teeth as chewing sticks. These plants possess antiseptic, antibacterial, antifungal, astringent, styptic, anti-inflammatory, sialogogue, antiviral as well as anti-cariou properties.<sup>9</sup>

Figure 1

Table –I: Indian plants and their parts used as chewing sticks

S. No.	Plants	Local name	Parts used	Useful properties
1	<i>Salvadora persica</i>	Miswak	Fresh young part of stem /branches	Astringent, antibacterial
2	<i>Azadirachta indica</i> (meliaceae)	Neem	Stem, branches	Bitter, astringent, antiseptic, antibacterial, analgesic, anti-inflammatory, antiviral, antifungal.
3	<i>Acacia Catechu</i> (Mimosaceae)	Khair	Stem, bark	Astringent, cooling, antiseptic, anti-inflammatory, bitter.
4	<i>Acacia nilotica</i> (Mimosaceae)	Kikar	Stem, branches	Astringent, styptic, antibacterial, antifungal, acrid.
5	<i>Acacia leucophloea</i> (Mimosaceae)	Safed babul	Stem, branches	Astringent, styptic, antibacterial, antifungal.
6	<i>Achyranthes aspera</i> (Amaranthaceae)	Apamarga	Stem, bark	Anti-inflammatory.
7	<i>Aegle marmelos</i> (Rutaceae)	Bael tree	Stem, branches	Astringent, antibacterial.
8	<i>Butea monosperma</i> (fabaceae)	Dhak	Stem, branches	Astringent, bitter, antibacterial, anti-inflammatory, antifungal.
9	<i>Calotropis procera</i> (Asclepiadaceae)	Madar, AK	Stem	Astringent, antimicrobial, antiseptic, styptic.
10	<i>Nerium indicum</i>	Kamer	Stem, branches	Antibacterial, analgesic, anti-inflammatory, antifungal.
11	<i>Pongamia pinnata</i> (fabaceae)	Karanj	Stem, root	Astringent, styptic, antiseptic, antibacterial, antifungal.
12	<i>Pterocarpus marsupium</i> (fabaceae)	Vijayasar	Stem	Astringent, styptic, antifungal, anti-inflammatory.
13	<i>Terminalia arjuna</i> (comufretaceae)	Arjun	Stem, branches	Astringent, styptic, cooling, demulcent, antibacterial, antifungal.
14	<i>Ficus racemosa</i> (Moraceae)	Gular	Stem, branches and bark	Astringent, antiseptic, antifungal, anti-inflammatory.
15	<i>Ficus fenghalensis</i> (Moraceae)	Bargad	Stem, branches	Astringent, styptic, anti-inflammatory, analgesic, antioxidant.
16	<i>Glycyrrhiza glabra</i> (fabaceae)	Mulharti	Stem, branches	Demulcent, haemostatic, antimicrobial, anti-inflammatory, antiviral, analgesic.
17	<i>Zanthoxylum aromatum</i>	Tejovati	Stem, branches	Astringent, antiseptic, antibacterial.

## MECHANISM OF ACTION

Miswak is generally used for a longer period of time than is a modern toothbrush and the cleaning is usually implemented for 5 to 10 min each time<sup>10</sup>. The plant fibers remove plaque and simultaneously massage the gums. Cleansing efficacy of miswak is attributed to the mechanical effects of its fibers, release of beneficial chemicals or a combination of both.<sup>11</sup> Further it stimulates salivation and thus there may be a better cleansing effect. Some African chewing sticks are also reported to contain fluoride ions, silicon, tannic acid, sodium bicarbonate and other natural plaque inhibiting substances that can reduce bacterial colonization and plaque formation.<sup>6</sup> Chemically, the air dried

stem bark of *S. persica* is composed of trimethylamine, salvadorine, chlorides, high amounts of fluoride and silica, sulphur, vitamin C, small amounts of tannins, saponins, flavonoids and sterols.<sup>12, 13</sup>

The repeated process of using chewing sticks releases fresh sap containing fluoride, which seems to wet the tooth enamel and adequately reach caries susceptible sites and contribute towards caries prevention.<sup>5</sup> Tannin exerts an astringent effect on the mucous membrane, thus reducing the clinically detectable gingivitis.<sup>14</sup> Tannins also inhibit the action of glucosyl transferase thus reducing plaque and gingivitis.<sup>15</sup> Resins forms a layer over the enamel and thus protects against caries. Alkaloids exert bactericidal effect in the oral cavity.<sup>16</sup> Essential (volatile) oils possess characteristic aroma and exert antiseptic action.<sup>17</sup> The mild bitter taste stimulates the flow of saliva, which is antiseptic.<sup>18</sup> The sulfur compounds have a bactericidal effect.<sup>19</sup> Vitamin C is antioxidant and helps in the healing and repair of tissues. Sodium bicarbonate has mild abrasive properties and is, thus, used as a dentifrice in addition to having a mild germicidal action.<sup>20, 21</sup> The high concentrations of chloride inhibit calculus formation<sup>22</sup> and help in removing stains from the teeth.<sup>17</sup> Calcium saturation of saliva inhibits demineralization and promotes re-mineralization of tooth enamel.<sup>15</sup>

The root of *Salvadora persica* contains a steam-distillable oil composed of 10% benzyl nitrate and 90% Benzylisothiocyanate (BIT).<sup>23</sup> BIT is classified as one of the chemo-preventive agents that are thought to prevent carcinogenic and other genotoxic compounds from reaching or reacting with the target sites on the treated tissue.<sup>24</sup> BIT is reported to have a virucidal activity against herpes simplex virus-I (HSV-I) at a concentration of 133.3 mg/ml.<sup>25</sup> In addition, it has been shown to possess a broad-spectrum bactericidal activity.<sup>26</sup> Al-Lafi et al reported that BIT inhibits the growth and acid production of streptococcus mutans.<sup>27</sup>

## EFFECT ON DENTAL PLAQUE

It is claimed that the mechanical plaque-removing properties of chewing sticks may be similar to that of a conventional toothbrush.<sup>26, 28</sup> Al-Otaibi et al 2003 studied the effects of the chewing stick and tooth brushing on plaque removal and gingival health and concluded that miswak is more effective than tooth brushing for reducing plaque and gingivitis when preceded by professional instructions. Further they state that miswak appeared to be more effective than tooth brushing for removing plaque from the embrasures, thus enhancing

inter-proximal health. Various other studies have also demonstrated the usefulness of chewing sticks.<sup>29</sup> Hardie and Ahmed stated that the plaque removing properties of miswak and conventional tooth brushes are similar.<sup>30</sup>

Ndungu et al studied the efficacy of chewing stick and concluded that patients with severe plaque deposition, the tooth brush is more efficacious than the chewing stick in plaque control. However, for patients with moderate plaque deposits, the chewing stick is as efficacious as the tooth brush in plaque control.<sup>31</sup>

Danielsen et al assessed the efficacy of brushing with chewing sticks on plaque removal and concludes that brushing with a chewing stick for five minutes resulted in a net reduction of the proportions of plaque deposit sites per child and the tooth paste resulted in no additional effect.<sup>32</sup>

Helderman et al compared the oral hygiene of habitual chewing stick and tooth brush used in children in the age group of 10-13 years. They reported that though at baseline, chewing stick user exhibit statistically significant more plaque, but their gingival condition was comparable with tooth brush users. Further at three months, the chewing stick and the tooth brush users had reduced their plaque and gingival bleeding scores significantly to the same extent. The authors suggest that effective tooth brushing was helpful to improve oral hygiene regardless of whether chewing stick or tooth brush is used.<sup>33</sup>

### EFFECT ON PERIODONTAL HEALTH

Eid and Selim examined the relationship between miswak and gingival health in terms of pocket depths, periodontal disease severity and gingival recession in 264 patients who were on routine periodontal treatment. They suggested that the use of miswak may influence periodontal health and may be considered as a contributing factor to gingival recession.<sup>34</sup>

Nortan and Addey recorded the oral hygiene and gingival health of adult Ghanians who used chewing sticks, tooth brushes or a combination of both for tooth cleaning. Plaque and gingivitis scores were higher in chewing sticks users. They further reported that men had poorer oral hygiene and gingival health than women, irrespective of oral hygiene regimen. They suggested that longer time is necessary for the cleaning with chewing sticks may explain the apparent reduced cleaning efficiency in men. They also concluded that the antimicrobial substances in chewing sticks appear to provide no additional benefits to those produced by the antimicrobial activity of commercially available

toothpastes.<sup>35</sup>

Rinsing with slurry of miswak toothpaste reduces gingival inflammation and bleeding on probing.<sup>36</sup> Chlorhexidine and miswak were compared and chlorhexidine (CHX) was found to be more effective than miswak in plaque reduction. It was found that streptococcus mutants were eliminated in the miswak group and were less in CHX. Gazi et al<sup>37</sup> reported that plaque and gingivitis were significantly reduced when miswak was used 5 times a day compared with conventional toothbrush. Guile et al concluded from a survey of Saudi school children that the low incidence of periodontal disease was attributable to the practice of using miswak for teeth cleaning.<sup>38</sup> In general, it is concluded from the above-mentioned studies that reduction in plaque leads to a decrease in gingivitis and ultimately a reduction in bleeding from the gums.

### ANTIBACTERIAL ACTIVITY

Miswak has got antibacterial activities. Almas and Al-Zeid tested the antimicrobial activity of *Salvadora persica* in vivo on *Streptococcus mutans* and *Lactobacilli*. There was a marked reduction of *Streptococcus mutans* among all groups. When the groups were compared, the reduction of *Streptococcus mutans* was significantly greater using miswak in comparison to tooth brushing and there was no significant difference for *Lactobacilli* reduction.<sup>39</sup>

Almas compared the effectiveness of antimicrobial activity of *Salvadora persica* (Arak) and *Azadirachta indica* (Neem) chewing sticks extracts at various concentrations. The pH of neem and arak extract was 6.1 and of 4.9 respectively. The authors reported that both chewing stick extracts were effective at 50% concentrations on *Streptococcus mutans* and *Streptococcus faecalis*. Arak extract was more effective at lower concentrations for *Streptococcus faecalis*.<sup>40</sup>

Taiwo et al studied the antibacterial activity of 10 aqueous extracts of wooden chewing sticks widely used in Nigeria against 25 different bacteria. These workers observed that extracts from five sticks namely *Garcinia kola*, *Anogeissus leiocarpus*, *Terminalia glaucescens*, *Sorindeia warneckei* and *Vitex doniana*, exhibited strong activities against methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant *Enterococcus*, multidrug-resistant *Burkholderia cepacia* and *Pseudomonas aeruginosa*. They also suggested that antibacterial activities were distributed into different fractions suggesting that the sticks contain different types of principle responsible for antibacterial activity. Antibacterial activity may contribute to the reported anti-caries effect of

chewing sticks.<sup>41</sup>

Hattab analyzed the chewing sticks of *Salvadora persica*, the most common source of miswak for their soluble and total content of fluoride, calcium, phosphorous and silica. The fluoride released from the miswak soaked in water was negligible (<0.07 microgram/ml) approximately 39% of the total fluoride in the sticks was a form that could be leached out. The leached calcium and phosphorous in the chewing sticks averaged 582 microgram/ml and 34 gm/ml respectively, representing 19.6% and 26.4% respectively of their total contents. These authors suggested that miswak was probably not particularly active against caries through its fluoride content, but it does act as a brush for removal of dental plaques and polishing teeth.<sup>28</sup>

Rotimi and Mosadomi studied in-vitro susceptibility of nine chewing stick extracts used in Nigeria on four species of bacteroids and reported that all the black-pigmented oral anaerobes were very susceptible to eight of the nine chewing-stick extracts but non-pigmented anaerobes showed variable susceptibility.<sup>42</sup>

### CYTOTOXIC EFFECTS

Mohammed and Turner<sup>23</sup> were the only one who studied the cytotoxic potential of the miswak using the agar overlay method. No cytotoxic effect had been noticed.

### ADVANTAGES

Chewing stick is an affordable oral hygiene device. Natural toothbrush sticks can be used by the vast majority of people. Another advantage is the ready availability in towns or villages. In addition, as it is dry and small size, it is easily carried around, hence enabling the user to prompt use after every meal. The relative accessibility and popularity of chewing sticks in the Middle East and Africa as an oral hygiene tool make it a cost effective agent for plaque control in such communities. Their taste is agreeable and reported to have anti-plaque and many other pharmacological properties.<sup>43,44</sup> Whenever miswak is used, both the teeth and the tongue are cleaned. Miswak has various therapeutic uses such as benefits from the juice of the stick extracted on chewing (antibacterial extracts) and its functional aspects of chewing as a jaw exerciser, as well as a Sialogogue - a reflex induction of copious saliva - which is beneficial to the oral hygiene and general health. It can also be used in the development of dentition during eruption.<sup>17</sup> It may improve appetite and regulate peristaltic movements of the gastrointestinal tract.<sup>15</sup>

### DISADVANTAGES

However, the bristles may penetrate the gums during use thus causing some discomfort.<sup>6</sup> Unlike a modern toothbrush, the bristles of miswak are situated along the long axis of its handle. Consequently, the facial surfaces of the teeth can be reached more easily than the lingual surfaces or the interdental spaces. The direction of cleansing bristles is parallel to the long axis of stick, thus it may not be possible to access all the surfaces of whole dentition easily.

### CONCLUSION

Oral hygiene is important for the well being of whole body. The use of toothbrush sticks for the oral and dental hygiene is well documented. Chewing sticks are used for not only for oral hygiene but for religious and social reasons. The use of natural toothbrush can be made more beneficial by proper technique and regular use particularly in rural areas.

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