Abstract

Salvadora persica (Miswak or Meswak, also known as Arak in Persian) is a shrub of the family Salvadoraceae originally native to southern regions of Iran, which its leaves, fruits, seeds, barks and roots have many therapeutic uses. The plant root is a wood like the toothbrush bristles, which has been used previously instead of current toothbrush to clean the teeth.

This research was conducted with the aim of introducing potential pharmaceutical commercialization of toothbrush plant through library searches and online authentic resources in accordance with the current scientific and practical findings in the field of health by using the data collection tools, exploration and studies on the available references. For this purpose, relevant contents were searched firstly in the Holy Quran, Hadith, and credible sources such as medical and historical books, and then data were analyzed and integrated by presenting current pharmacological properties and samples of Salvadora persica. The results showed that medicinal use of toothbrush plant is successful and it has been considered in the pharmaceutical industries in some countries such as Britain, Sweden and Pakistan. The scientific studies and the
cultivation possibility of this plant justify the investment and monetization in various regions of Iran to develop, produce and export of pharmaceutical products obtained from toothbrush plant as well.

**Keyword:** Toothbrush Plant, Salvadora persica, Miswak, Oral health, Dental health, Meswak

**Introduction**

Today, effectiveness, benefits, harmless or less harmfulness use of traditional herbal medicines have been proven in many scientific communities. In the meantime, it can be referred to the findings of oral and dental researcher in the survey on the use of certain plants and natural materials in order to prevent the growth of bacteria in the mouth and tooth decay (1, 2). The use of toothbrush plant is miraculously effective in preserving and promoting oral and dental hygiene, especially in preventing tooth decay (3). Researches on traditional medicines in order to protect and improve the health of oral and dental in the past demonstrate that the toothbrush plant is the most prized medicinal plants in this field (4). The toothbrush plant is an evergreen shrub that has smooth, shiny, pale and hanging branches, bony and spear-shaped oval leaves, white open inflorescences and small red fruits with yellow seed called as Kobat or Khomt and Jehaz (5). This shrub is a species of the family Salvadoraceae with scientific name of *Salvadora persica* and with the generic name of Miswak or Meswak, which is called Mesuak in French, Chooj in Bandar Abbas and Chabahar, Iran, and Arak in traditional books (6). This plant is known by various names in different languages, such as Arak in Persian, Miswak in Arabic, Koyoji in Japanese, Qesam in Hebrew, Qisa in Aramaic, Mastic in Latin (5). The plant grows in Bandar Abbas, Nay Band, Lar, Minab and Jask and Chabahar (Iran), Makran (Iran-Pakistan), India, Egypt and Ethiopia. Its leaves, fruit, seeds, bark and roots have many therapeutic uses (7). The toothbrush plant, so named because its root is a wood like the toothbrush bristles, which has been used previously instead of current toothbrush to clean the teeth (8). Longitudinal fibers of the bark are guided gently on the teeth, like a toothbrush.

By this action, in addition to brushing teeth, the wood-containing compounds dissolve in saliva and its therapeutic impacts act in the mouth, gums and teeth (9). The toothbrush plant was native to Iran originally, and then was spread to neighboring countries including Saudi Arabia, but now no longer exists in Iran. In fact, Linnaeus who is the famous botanist in the world derived the term Persica from Persian 400 years ago (5, 10, and 11). History of using wood and roots as a toothbrush goes back to Babylonians around 3500 BC (11). The use of toothbrush plant in the field of oral and dental hygiene and health has been mentioned in Islamic texts (12). The Holy Prophet Muhammad (PBUH) applied the Arak tree for brushing by order of Gabriel (13).
Islamic medicine teachings and repeated orders of the Holy Prophet Muhammad (PBUH) in about 1430 years ago on the oral and dental health care resulted in the widespread use of this plant among the other Imams (AS) and Islamic countries (4).

The World Health Organization has reported a very important role and influence of these pieces of wood in oral and dental health promotion in the past (14, 15). Accordingly, the Muslims continue their brushing by fragrant Arak based on tradition more than a thousand years (16).

Materials and methods

Researches on the scientific and historical resources have always been following the teachings and special instructions for preserving and improving human health. Hence, this theoretical-review research was conducted with the aim of studying pharmaceutical commercialization system of medicinal plant related to health through library authoritative sources and traditional teachings and those texts with scientific and practical findings associated with human oral and dental health by using the data collection tools, exploration and studies on the available references. For this purpose, relevant contents were investigated firstly in the Holy Quran, Hadith, and credible sources such as medical and historical books, and then data were analyzed and integrated by presenting current pharmacological properties and samples of Salvadora persica.

Results and discussion

Maintaining and taking care of health of oral and dental are important issues for a very long time (17). Attention to this important issue can be found frequently in historical books and documents available in the country. In recent years, health and medical researchers have demonstrated the relationship between oral and dental diseases and disorders in other body organs (18). Poor oral and dental hygiene at the right time leads to form germ layers; damaging acids resulting from the microbial activities in these layers are produced 2 to 5 minutes after using sugar and food that remain in the mouth for 20 to 60 minutes. The produced acid destroys tooth enamel, and tooth decay begins then. The tooth decay, gum disease and gastrointestinal disease cause bad breath (halitosis) (19). Throat, mouth and nose are cavities for bacteria to grow, as well as grooves on the tongue are also the perfect place for buildup of bacteria. Types of gum disease, maxillary and mandibular bones and salivary glands can also cause halitosis (20). The bacteria release sulfur compounds such as hydrogen sulfide that are the source of bad breath (21). Exacerbated nonfatal cardiovascular disease by about two times higher in people with dental calculus, impaired blood sugar control in diabetic patients, and focal rash and hair loss are the common side effects of poor individual oral and dental hygiene (22, 23). Less dental caries among toothbrush plant users
have prompted researchers to investigate the antimicrobial properties of its chemical substances, especially trimethyl (24). The leaves, trunks, fruits and roots of *S. persica* contain various ingredients, including: amine and dihydroisocoumarin; dimeric alkaloids called Salvadorin; large amounts of chlorides particularly sodium and calcium, phosphorus, silicon, calcium oxalate, fluoride, silica; sulfur-containing compounds such as gypsum, saponins, resins, vitamin C, tannins, tannic acid; alkaloids such as trimethylamine; β-sitosterol, and m-anisic benzyl isothiocyanate, sodium bicarbonate, glycosides; organic compounds such as pyrrolidine, pyrrole, piperidine derivatives; glycosides such as salvadoside and salvadoraside; small amounts of tannins, saponins, sterols, and flavonoids such as kaempferol, quercetin, quercetin rutin and quercetin glucoside (5, 18, 25-27). Salvadorins and alkaloids have antimicrobial and mild stimulating effects on gums (18). The toothbrush plant can prevent diseases caused by periodontal bacterial pathogens due to inhibitory activities on proteases and peptidases enzymes (28). Ash constitutes about 27 percent of the roots and bark of the toothbrush tree containing alkaloids, especially salvadorins and trimethyl amine, chloride and fluoride; and modest concentrations of silica, sulfur and vitamin C; as well as smaller amounts of tannins and saponins, flavonoids and sterols (5). Trimethylamine prevents the accumulation of food particles between the teeth (29). Methylamine as an abrugerent improves mouth ulcers, makes healthy growth, and causes modifying and reducing the index of hydrogen ion activity in the oral cavity that indirectly affects the oral microbial growth (17). There are significant amounts of sodium chloride and potassium chloride along with sulfur in the persica plant. These substances, in addition to mild disinfecting role, cover the enamel through adhesion properties, prevent tooth decay and dental germ, and help to remove stains and deposits on the tooth surface (30). There is sulfur at a concentration of 4.73% in the ash resulting from the plant roots, which alone has a bactericidal effect (16). Fluoride strengthens the tooth enamel structure. Some studies have reported that the plant root soaking in water causes release of fluoride at concentrations between 0.07 and 0.1 µg/ml (31). Tannins in persica plant have strengthening property for the gums, and help to reduce gingivitis (32). Flavonoids and tannins, in addition to having strong anti-ulcer effect for gums, inhibit the activity of glucosyltransferase to prevent the formation of calculus and gingivitis (33). Vitamin C and sitosterol have potential role in boosting blood flow to the capillaries of the gums, restoration, healing and preventing the gingivitis. Some substance also available in Arak prevents tooth decay and abrasion, and subsequently inhibits the formation of purulent cavities (34). Investigations also indicated that frequent chewing persica plant root causes the release of fresh resins with anti-cancer effects. The resin also protects the teeth against dental diseases by creating a coating layer (35). Silica plays an important role in teeth whitening, and vitamin C is
widely used in controlling oral infection (32, 34 and 36). Based on studies carried out in some countries, anti-microbial and anti-plaque effects of wood powder prepared from Arak were the same best form of commercial toothpastes. In recent years, many pharmaceutical manufacturers produced toothpastes and mouthwash drops containing extracts of roots and trunks of the Arak tree (5, 37). Calcium saturation, especially calcium bicarbonate, in the saliva caused by chewing the wood of persica plant roots allows faster regeneration of tooth enamel (38). Extraction of benzylisothiocyanate (BITC) from persica plant root suggests that BITC is a final anti-cancer and anti-genotoxic product resulting from the enzymatic hydrolysis of glucosinolate contained in the persica plant. The BITC is an inhibitory chemical substance, and its presence at the site is thought to be effective in preventing reach to the target tissue or response to carcinogens. The concentration of 133.3 µg/ml of BITC is virucide and manages to destroy herpes simplex virus 1 and a large range of bacteria, as well as it can prevent the growth and acid production by Streptococcus mutans (31). Investigations have demonstrated that antibacterial activity of toothbrush plant is selective and ideal, especially on anaerobic microorganisms such as S. mutans that causes tooth decay, and even fungi such as candida as well as can eliminate 97% of mouth germs in a short time (39). Some studies have reported that high concentrations of sulfate in the toothbrush plant extract prevent the growth of Candida albicans (40). Al Lafi (1995) reported that the persica plant derivatives have strong germicidal effects, particularly Streptococcus and Staphylococcus aureus (40). Almas and his colleagues also found that Enterococcus faecalis decreased in the mouths of subjects who had used the toothbrush plant about a month compared with those who had used shortly (41). Albaghie compared the bactericidal properties of aqueous and alcoholic extracts of toothbrush plant roots and concluded that ethanol extract was strong bactericide than aqueous extract (42). Some studies have suggested that unknown anion compounds in the extract of toothbrush plant had no germicidal effects. However, it is thought that the increased secretion of thiocyanate and hydrogen peroxidase enzymes in the mouth enhances the germicidal systems in the saliva so that some harmful pathogens, especially Aggregatibacter actinomycetemcomitans were higher dominant in the saliva of people who had used the industrial toothbrush rather than persica plant (43). In some studies, there were bacteria such as A. actinomycetemcomitans, Staphylococcus intermedius, Veillonella parvula, Actinomyces israelii and Capnocytophaga gingivalis bacteria and substantially in fewer amounts of Selenomonas sputigena, Streptococcus salivarius, Streptococcus oralis and Actinomyces naeslundii in the mouth of people who had used the toothbrush plant (31). Some other researches also reported a further reduction of A. actinomycetemcomitans when using industrial toothbrush compared to the use of toothbrush plant (44). Investigate the effect of persica plant root and its extract on
reducing the growth of two species of *S. mutans* and Lactobacillus bacteria in the study of Sulaiman and Al-Bayati indicated that the *S. mutans* bacteria has fallen well, but no change was found in the growth of Lactobacillus. They also examined the bactericidal effect of aqueous and alcoholic extracts of toothbrush plant roots on seven harmful strains isolated from mouth, including *S. mutans*, *S. aureus*, *Streptococcus pyogenes*, *Pseudomonas aeruginosa*, *C. albicans*, *E. faecalis* and *L. acidophilus*. They reported that both extracts could well destroy the microbes and finally the aqueous extract had better performance than the alcoholic extract, because the two *L. acidophilus* and *P. aeruginosa* species showed resistance to the alcoholic extract (45). The persica plant derivatives can show good germicidal effects, which can be extracted by dissolution in various chemicals, including water and alcohol. Anti-cancer and anti-bacterial properties have been reported in several studies in people who had used the toothbrush plant. One of the causes to reduce caries rate and even the lack of it is that materials in persica plant, can lead to the neutralization of acid in the oral cavity by increasing the salivation, resulting in failure to damage calcareous tissue of teeth and enamel (46). Eight days of using persica plant root without requiring any special technique could reduce 75% of oral-dental germs (31). Hattab has considered more efficient the reduction of dental germs using the toothbrush plant rather than the industrial Oral-B toothbrush, and introduced both physical act and salivation caused by substances contained in plants persica the reason for the outcomes. In fact, physical cleansing is the first effective measure in brushing (8). In contrast, some other studies consider the use of chlorhexidine more efficient compared to persica plant (47). Khaleesi reported that commercial extract prepared from the toothbrush plant reduced greatly gingival bleeding (36). Some reports show that the toothbrush plant has vasoconstrictor properties, reducing gingivitis (48). Tubaishat and Hooda believe that both persica plant and commercial toothbrush are the best options available for keeping oral and dental health (49). The persica plant in addition to maintaining and improving oral and dental health helps to digest food; for example, a rather bitter taste of oils in the plant triggers and secretes more saliva, resulting in better activities of other digestive enzymes (50). The toothbrush plant contains a large amount of sharp-taste substance, which is antiseptic, abstergent, inhibitors of bleeding gums and gum reinforcing. Thiocyanate compounds in the plant has a strong influence on salivary peroxidase system with antimicrobial effect and gives rise to specific and nonspecific tissue resistance mechanisms against infections (8). The active ingredient of toothbrush stick called benzyl isothiocyanate dissolves in saliva after entering the mouth; this substance combines with one atom of oxygen in H₂O₂ produced by oral microbial activities and finally produces water and the new composition of benzyl isothiocyanate oxide. As a result, hydrogen peroxide in the saliva neutralizes, reducing damage to the tissues of the
oral mucosa. The produced benzyl isothiocyanate oxide has stronger antimicrobial effect than benzyl isothiocyanate. The benzyl isothiocyanate is secreted naturally in small amounts by the salivary glands in the mouth, and this is one of the wonders of the toothbrush plant that is unique (39). Among the compounds of Arak, anisic acid helps to chest sputum removal. In addition, there are some ascorbic acid and sitosterol, which strengthen blood vessels leading to gingivitis (32). Also, 1% aromatic oil can be found in this plant that leads to fragrant mouth. Another substance is enterolithon that is useful in strengthening appetite, eating and in regulating bowel movement (10). Results showed that the antimicrobial properties of Miswak starts from the moment of entering the mouth and lasts a long time, while toothpaste has a very short durability so that is not comparable with Miswak (36). Many other compounds form after reacting with saliva, which the explanation is beyond the scope of this article. All these studies show that the use of toothbrush wood, especially in the long term, can have tremendous and ideal effects on the oral and dental health (11). In addition to the above benefits, the use of this valuable wood reduces human contact with many chemicals causing many current physical ailments (51, 52). All studies have reported the unique properties of substances and effects of Miswak (39). The Islamic medicine teachings are of great importance in the Quranic verses and the hadiths. So that part of the teachings of Islamic medicine devoted to the role of medicinal plants in the treatment of diseases to realize the importance of their use in some stage of human life with inspiration from these issues, in addition to gaining knowledge of God. The Holy Quran and Hadith of Ahl al-Bayt (AS) have hints and specific teachings, which can create advancing and developing fields for Muslims in different areas.

Conclusion

This study was carried out with the aim of introducing potential pharmaceutical commercialization of toothbrush plant (Miswak) or *Salvadora persica*. The results showed that the use of pharmaceutical extracts of Miswak such as persica mouthwash has been studied in many researches in the prevention and treatment of many diseases, including oral and dental diseases and has been considered in the pharmaceutical industries in some countries. Moreover, the findings also indicated that this plant is native to Iran originally; but unfortunately, some raider countries have looted and recorded the name of this plant, because of Iranian institutional neglect, like other genetic resources of the country. Since there is a cultivation possibility of this plant in most parts of Iran and the plant's natural habitat is originally this country, so growing the plant can be considered for the production and export of the pharmaceutical products obtained as well as for beneficial use of the potential of the local investment to create income and entrepreneurship.
References


**Corresponding Author:**

Mehdi Saedi

*Email: saeedi_mahdi@yahoo.com*