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Review Article

A REVIEW: NUTRITION AND ORAL-DENTAL HEALTH, PHYTOCHEMICAL CONTENT, BIOLOGICAL ACTIVITY OF *SALVADORA PERSICA* (MISWAK)

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ABSTRACT

Plants have been widely used by humans since ancient times. They serve different purposes, especially shelter, heating, nutrition, war, equipment and medicine. Nowadays, they are widely used especially in the fight against diseases. In this context, in this study, the biological activities and health effects of *Salvadora persica* L. reported in the literature were compiled. *S. persica* is known by names such as miswak, koyoji, qesam, qisa and mastic. It is a multi-branched shrub or small tree that is two to three meters tall and has edible fruit. As a result of literature research, it has been seen that the plant has purposes such as health care and nutrition source. In addition, it has been shown in the literature that it has biological activities such as antioxidant, antimicrobial, anthelmintic, cytotoxic, anti-inflammatory and antidepressant activity. The most common and highly abundant compounds in the root, twigs, and leaves of *S. persica* were found to be benzyl isothiocyanate, benzyl nitrile, 1,8-cineol, butylated hydroxytoluene, isothiocyanatomethyl-benzene, and (2E)-hexenal. As a result, it is thought that *S. persica* can be used as a natural protective agent in terms of both its usage areas and biological activities.

KEYWORDS: *Salvadora persica*, miswak, biological activity, oral and dental health, nutrition.

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1. Introduction

It has been seen that plants have been used in many different areas such as dressing, shelter, nutrition, spices and cosmetics from ancient times to the present day. Today, plants have been the subject of many studies in terms of biological activity due to their active ingredients [1]. It has been reported in the literature that plants have biological activities such as anticancer, antioxidant, antimicrobial, analgesic, antiviral, hepatoprotective, and DNA protective [2-6]. The sticks made from twigs after being collected of the *Salvadora persica* L. (Salvadoraceae) tree are called "miswak" in Arabic, "koyoji" in Japanese, "qesam" in Hebrew, "qisa" in Aramaic, and "mastic" in Latin [7]. Additionally, *S. persica* is also called Arak tree (toothbrush tree) in the literature [7]. *S. persica* is a multi-branched shrub or small tree that is two to three meters tall and its fruit is edible. The shell parts are scaly and

cracked. The tips are droopy and whitish [8]. It has clusters of small red edible fruits that are juicy but pungent. It is distributed in the equatorial regions of Mauritania, Sudan, Ethiopia, Egypt (Red Sea), Central Africa, Saudi Arabia, Yemen, Oman, Palestine, Israel, Iran, Pakistan, Afghanistan and Bharat [7,9,10].

2. Usage areas

The stick from *S. persica* is popular for cleaning teeth in the Arabian Peninsula and Iranian Plateau, as well as in wider Muslim communities. Toothbrushes obtained from the 3-5 mm diameter roots and small branches of the plant have been used by Muslim communities in India, Arabia and Africa for more than 1000 years. It is thought to suppress bacterial growth and plaque formation. The flowers of *S. persica* are small and fragrant and are

used as a stimulant and a mild laxative. Fruits are small. They can be eaten both fresh and dried. The wood of the plant is used as kindling and fuelwood [11]. In addition, its uses in health care include toothbrushes, toothpaste, mouthwashes and root canal irrigators, as well as stomach disorders, rheumatism, respiratory diseases and snake bite treatment [12-14].

3. Biological activities

Plants are very important natural resources in terms of biological activity. These properties come from the phenolic compounds found in plants [15]. In this study, the biological activities of *S. persica* reported in the literature were compiled. In this context, it has been seen in the literature that solvents such as methanol, chloroform, ethanol, acetone, water and petroleum ether are used. The biological activity studies of *S. persica* are shown in Table 1.

Table 1. Biological activities of *Salvadora persica*

Biological activities	Extractions	Used parts	Ref.
Antioxidant, antimicrobial, anthelmintic, cytotoxic, anti-inflammatory, antidepressant, hepatoprotective, analgesic, anticoccidial, antiviral	Methanolic, chloroform, ethanolic, acetone, aqueous, petroleum ether, benzene, hexane, alcoholic, ethyl acetate, n-butanol, crude extract, hydro-alcoholic	Root, twig, explants, leaves, fruit, branch	[23-55]

3.1. Antioxidant activity

Reactive oxygen species are oxidants produced in living cells as a result of metabolic activities [16]. Although these compounds are tolerated at low levels, they can cause serious damage as their levels rise. The antioxidant defense system functions in reducing the effects of oxidant compounds [17]. Oxidative stress occurs as a result of the imbalance between the antioxidant defense system and oxidant compounds [18-19]. As a result of oxidative stress, serious diseases such as cancer, neurodegenerative diseases, and cardiological disorders may occur [20-21]. Supplementary antioxidants are used to suppress or reduce the possible effects of oxidative stress. In this context, researching antioxidant properties of plants is very important in terms of supplementary antioxidant sources [22]. In this study, antioxidant activity studies of *S. persica* reported in the literature were compiled. In a study, the antioxidant activity of the methanol extract of *S. persica* was determined using 2,2-diphenyl-1-picrylhydrazyl (DPPH) and 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid (ABTS) tests. According to the results obtained, the IC50 value of the DPPH test was reported to be 4.8 µg/mL, and the ABTS test result was 1.6 µg/mL [23]. The antioxidant status of chloroform and ethanolic extracts obtained from the twigs and stem of *S. persica* was investigated using the DPPH test. As a result of the study, the IC50 value for the twig was reported as 181.33 µg/mL for the chloroform extract, 197.00 µg/mL for the ethanolic extract, the IC50 value of the chloroform extract of the trunk was 187.33 µg/mL, and the IC50 value of the ethanolic extract was 235.66 µg/mL [24]. In a different study, the antioxidant potential of *S. persica* was determined using DPPH, ferric reducing antioxidant potential (FRAP) and the PMS/NADH

system tests. As a result of the study, it was reported that the clearance percentage of DPPH value was 58-82%, PMS/NADH system value was 9-12%, and FRAP value was 11-17 mmol Fe²⁺g⁻¹ [25]. In a different study, the antioxidant status of acetone extract obtained from the root part of *S. persica* was examined by DPPH, β-carotene bleaching, reducing power and superoxide anion radical scavenging tests. As a result of the study, it was seen that the IC50 value of the DPPH test result was 75 µg/mL, the IC50 value of the β-carotene bleaching test result was 460 µg/mL, and the half-maximum effective concentration EC50 value of the reducing power was 1940 µg/mL. Additionally, the superoxide anion radical scavenging result could not be determined [26]. In a different study, the hydrogen peroxide scavenging activity of the aqueous, methanolic and ethanolic extracts obtained from the root sample of *S. persica* was examined. As a result of the research, it was reported that the percentage value results of the extracts used were 17-43.9% for aqueous, 9.5-43.9% for methanolic and 9.5-45.3% for ethanolic ones [27]. In a different study, it was reported that the IC50 value of the methanol extract of the root parts of *S. persica* was 15.47 mg/mL in the DPPH test [28]. In a different study, IC50 values of *S. persica* petroleum ether extract using DPPH and ABTS tests were reported to be 20 µg/mL and 35 µg/mL, respectively [29]. In a different study, as a result of the DPPH test of the methanol extract of the root parts of *S. persica*, it was reported that the clearance and inhibition percentage were in the range of 5-30% [30]. In a different study, a new imidazoline alkaloid 1,3-dibenzyl-4-(1,2,3,4-tetrahydroxy-butyl)-1,3-dihydro-imidazole was obtained from *S. persica*. Additionally, the antioxidant potential of this alkaloid has been reported using DPPH, superoxide anion and nitric oxide radical scavenging tests [31]. In a different study, the antioxidant status of the extract obtained from the twigs of *S. persica* was analyzed by DPPH, ABTS and Pirogallol red bleaching tests. As a result of the study, IC50 values of the tests used were reported as 85.67, 49.10 and 336.50 µg/mL, respectively [32]. In a different study, the antioxidant activity of petroleum ether, benzene, chloroform, methanol and aqueous extract obtained from the leaves of *S. persica* was analyzed using superoxide radical scavenging, hydroxyl radical scavenging, metal chelation and reducing power tests. As a result of the study, it was reported that the best percentage of DPPH scavenging was 80.25% for methanol extract at 0.5 mg/mL concentration and the superoxide radical scavenging percentage was 75.76%. Additionally, it was reported that the inhibition value range was 70-80% as a result of the hydroxyl radical scavenging test, and the inhibition percentage range was 70-75% as a result of the metal chelation test [33]. In a different study, the antioxidant status of the methanol extract obtained from the root of *S. persica* was determined using total antioxidant activity, chelation of Fe²⁺ ions, hydrogen peroxide scavenging, hydroxyl radical scavenging, nitric oxide scavenging and DPPH tests. As a result of the study, the inhibition percentages in the tests used were reported as 48.22-96.21%, 8.10-58.29%, 21.71-92.56%, 12.32-69.42%, 8.33-97.33% and 60.22-94.61%, respectively [34]. In this context, based on studies reported in the literature, it has been observed that *S. persica* may be an important antioxidant source.

3.2. Antimicrobial activity

In recent years, there has been an increase in the number of resistant microorganisms due to overuse of antibiotic drugs [35]. Due to the possible side effects of synthetic drugs and the inadequacy of the drugs used, researchers have turned to the discovery of natural antimicrobial drugs [36]. In this context, in our research, antimicrobial activity studies of *S. persica* reported in the literature were compiled. In a study, the effects of acetone extract of the root parts of *S. persica* against *Staphylococcus aureus*, *S. epidermidis*, *Micrococcus luteus*, *Pseudomonas aeruginosa*, *Salmonella typhimurium*, *Candida albicans*, *C. dubliniensis*, *C. glabrata*, *C. parapsilosis*, *C. krusei*, *C. famata*, *C. kefyr*, *C. sake*, *C. holmii*, *C. lusitaniae*, *C. intermedia*, *C. atlantica*, *C. maritima*, *Pichia guilliermondii* and *Pichia jardi* were investigated. As a result of the study, it was reported that the inhibition zone value range on bacterial strains was 7-10 mm and the inhibition zone value range on fungal strains was 6-11.33 mm. It has also been reported that 10 µl extract concentration and gentamicin (10 µg/disc) was used for positive control [26]. In a different study, the inhibition zone value of the methanol extract obtained from the root parts of *S. persica* against *P. aeruginosa*, *Acinetobacter baumannii* and *Enterobacter cloacae* was reported to be 20, 18 and 14 mm, respectively. It has also been reported that kanamycin, cefotaxim, fosfomycin, colistine, chloramphenicol and ticarcilin were used for positive control [28]. In a different study, the minimum inhibitory concentration (MIC) value of petroleum ether extract of *S. persica* against *Streptococcus* species reported to vary between 5.53-12.5 mg/mL. It has also been reported that penicillin was used as a positive control [29]. In a different study, the antimicrobial status of the aqueous and methanol extract obtained from the root of *S. persica* sample was investigated against *S. aureus*, *S. mutans*, *S. faecalis*, *S. pyogenis*, *P. aeruginosa*, *C. albicans* and *Lactobacillus acidophilus*. As a result of the study, it was seen that the best inhibition zone value was 22.3 mm for the aqueous extract and 17.7 mm for the methanol extract, both in case of *S. faecalis*. Additionally, the best minimal inhibitory concentration (MIC) value of the aqueous extract against *L. acidophilus*, *P. aeruginosa* and *C. albicans* was found to be 6.25 mg/mL. It has been reported that methanol extract is effective against *S. aureus* and *C. albicans* at a concentration of 6.25 mg/mL. It has also been reported that the extract concentration was 12.5-200 mg/mL and streptomycin and amphotericin were used for positive control [37]. In a different study, they investigated the antimicrobial status of the methanol extract obtained from the aerial part of *S. persica* against *Streptococcus* spp. and *S. aureus*. As a result of the study, it was reported that the best inhibition zone value for *Streptococcus* species was 36 mm, and the best inhibition zone value for *S. aureus* was 35 mm. It has also been reported that the extract concentration was 12.5-200 mg/mL and ampicillin, piperacillin, amoxicillin/sulbactam, imipenem, levofloxacin, ofloxacin, doxycycline, gentamicin, vancomycin, rifamycin and nitrofurantoin were used for positive control [38]. In a different study, water, ethanol and hexane extract of *S. persica* were found to be effective against *E. coli*, *L. acidophilus*, *S. aureus*, *St. mutans* and *P. aeruginosa*. As a result of the study, it was seen that the best inhibition zone value for hexane extract was 15-20 mm effective

against *St. mutans*. It was observed that the ethanol extract exhibited activity against *St. mutans* with 35 mm inhibition zone. It has been reported to be effective against *St. mutans* and *P. aeruginosa* with 30-35 mm as a water extract. It has also been reported that the extract concentration was 100, 250 and 500 µg/ml and ampicillin and kanamycin were used for positive control [39]. In a different study, the antimicrobial activity of aqueous and methanol extract of *S. persica* against *S. aureus*, *St. pyogenes*, *E. faecalis*, *E. coli*, *Klebsiella pneumoniae*, *P. aeruginosa*, *Serratia marcescens*, *Acinetobacter baumannii* and *Stenotrophomonas maltophilia* was investigated. As a result of the study, it was seen that the best inhibition zone value for the aqueous extract was 12.3 mm against *E. coli*. It has been reported that the best inhibition zone value for methanol extract is 13.6 mm against *E. coli*. It has also been reported that the extract concentration was 50-400 mg/mL and vancomycin and tobramycin were used as positive control [40]. In a different study, the antimicrobial status of the aqueous and alcoholic extract obtained from the branch part of *S. persica* against *St. mutans*, *St. mitis*, *C. albicans*, *L. acidophilus*, *Prevotella intermedia* and *Peptostreptococcus* was investigated. As a result of the study, it was reported that the best inhibition zone value was 13 mm for the aqueous extract, which was effective against *St. mutans*. It has also been reported that the extract concentration was 200 µg/ml and 400 µg/ml, and chlorhexidine was used as a positive control [41]. In a different study, it was reported that petroleum ether, chloroform, ethyl acetate and methanol extracts obtained from the root of *S. persica* had antimicrobial activities against *S. saprophyticus*, *Proteus vulgaris*, *P. aeruginosa*, *S. aureus*, *Serratia marcescens*, *St. salivarius*, *St. mutans* and *C. albicans*. It has also been reported that the extract concentration was 5, 10 and 15 mg/ml, and gentamicin and amphotericin were used as positive control [42]. In a different study, the antimicrobial activity of petroleum ether and ethanol extract obtained from the fruit part of *S. persica* against *S. aureus*, *E. faecalis*, *St pneumonia*, *E. coli*, *P. mirabilis*, *P. aeruginosa*, *K. pneumoniae*, *C. albicans*, *St. mutans* and *Lactobacillus* spp. was investigated. As a result of the study, MIC and minimum bactericidal concentration (MBC) values were reported to be 3.12 and 6.25 mg/mL, respectively. It has also been reported that the extract concentration was 100 µg/mL and 500 µg/mL, and ampicillin was used as a positive control [43]. In a different study, the antimicrobial properties of essential oil, aqueous and alcohol extract obtained from the root of *S. persica* were analyzed. As a result of the study, it was reported that the best inhibition zone value was 16 mm for the essential oil against *E. coli*. It has also been reported that the extract concentration was 20 µg and erythromycin, nystatin, tetracycline and chloramphenicol were used for positive control [44]. In this context, according to studies reported in the literature, it has been observed that *S. persica* can be a natural antimicrobial source against different microorganisms.

3.3. Other activities

It has been reported in the literature that *S. persica* has different biological activities in addition to its antioxidant and antimicrobial activities. In this context, in the literature, the anthelmintic activity of the

methanol extract of *S. persica* against *Allolobophora caliginosa* has been investigated. As a result of the study, it was reported that at the most effective dose of 200 mg/kg, the time to paralysis and death was approximately 5 and 6 minutes, respectively [45]. In a different study, the cytotoxic effect of *S. persica* on oral squamous cell carcinoma (PE/CA-PJ15) was reported to be 11.25 mg/mL [46]. In a different study, the cytotoxicity of methanol, hexane, ethyl acetate and n-butanol extract obtained from the root of *S. persica* was investigated on human cancer cell lines HepG2, MCF-7, MDA-MB231 and HT-29. As a result of the study, it was seen that the IC50 value of the extract in respect to HepG2 cells was 17.36 µg/mL. It has also been reported that cytotoxicity did not occur at a concentration of 50 µg/mL for MDA-MB-231, MCF-7 and HT-29 cell lines [47]. In another study, the cytotoxicity of the methanol extract obtained from the branch part of *S. persica* on MCF-7, WEHI-164, HepG-2, MDBK and A-549 cell lines was investigated. As a result of the study, it was reported that the IC50 value was >50 µg/mL in all five cell lines used [48]. In a different study, the anti-inflammatory properties of aqueous alcoholic, crude extract and ethyl acetate extract of *S. persica* was analyzed in adult male Sapargue Dawely rats. Edema in the study was measured by measuring hindpaw thickness immediately before subplantar injection and at 1, 2, 3, and 4 hours. As a result of the analysis, it was reported that the application of alcoholic (crude) and ethyl acetate (fraction of a crude one) extract (100 mg/mL) significantly reduced the thickness of edema depending on time, and the percentage of inhibition of inflammation was 17% in the crude extract. It was determined that it was 27% in ethyl acetate extract. Ethyl acetate extract and both extract serums also reduced inflammatory mediators. It has also been reported to reduce the secretion of interleukin-1B (IL-1B), IL-6, tumor necrosis factor-α (TNF-α), and transforming growth factor-β1 (TGF-β1) [49]. In a different study, the anti-inflammatory effect of the aqueous extract of *S. persica* at 50, 75 and 100 mg/kg intraperitoneal administration on carrageenan-induced rat paw edema was examined. As a result of the study, it was reported that *S. persica* extract reduced inflammation 4 and 5 hours after carrageenan injection at a dose of 50 mg/kg [50]. In a different study, in order to evaluate the antidepressant activity of the aqueous extract of *S. persica*, depression status was examined in the forced swimming test in male albino rats depending on the duration of immobility, body weight, vital organ weight, blood sugar and the degree of DNA fragmentation that may occur, and leukocyte status. In the study, the extract was administered orally at a dose of 900 mg/kg for two weeks. As a result, it was reported that there was a significant ($p < 0.001$) decrease in mobility time, blood sugar and DNA fragmentation in rats, and the aqueous extract showed significant antidepressant properties when compared to the control group [51]. In a different study, it was reported that the protective effect against paracetamol-induced hepatotoxicity of the aqueous extract of *S. persica* on Albino Wister rats and mice showed a decrease of 190.23% and 131.13% in pyruvate transaminase levels at doses of 200 and 400 mg/kg, respectively [52]. In a different study, the analgesic effect of the hydro-alcoholic extract obtained from the root of *S. persica* was examined on mice at doses of 100 mg/kg, 200 mg/kg and 400 mg/kg. As a result of the study, it was reported that Eddy's hot

plate and tail immersion method showed significant activity after 30 minutes in all doses used with the hot plate and tail immersion method [53]. In a different study, the anticoccidial status of methanol extract obtained from the root of *S. persica* against infection caused by *Eimeria pailata* in mouse jejunum was examined. Three different doses of 300, 600, and 900 mg/kg were used after infection of mice with spore-containing oocysts. As a result of the study, it was reported that a dose of 300 mg/kg reduced the number of oocysts in the feces of mice by approximately 56.8% and also increased body weight [54]. In a different study, the antiviral status of the ethanolic extract obtained from the root of *S. persica* against bovine herpes-1 (BHV-1) was investigated. As a result of the study, it was reported that the virus titer decreased from 10^5 TCID50/ml to 10^3 TCID50/mL in the simultaneous incubation and adsorption step [55].

3.4. Nutrition and Oral-dental health

The importance of *S. persica*, which is mainly used in oral hygiene, in terms of nutritional value, has been given little attention in the literature. The first study in India to reveal the importance of *S. persica* fruit as a nutraceutical reported that the fruit extract has significant ROS scavenging properties, as well as high mineral and essential amino acid content. Among all amino acids measured, cysteine was found to have the highest amount (733.69 mg 100 g⁻¹ DW). Compared with similar medicinal plants and some commercially important fruits, *S. persica* fruit may be a potential source of essential mineral nutrients, amino acids, vitamins (ascorbic acid, carotenoids) to meet the recommended daily requirement for a healthy person [56].

Lack of hygiene in oral care accelerates the formation of microbes. And this causes tooth decay. Additionally, tooth decay, gum disease, and gastrointestinal diseases cause halitosis (bad breath) [57]. Found in the leaves, stems, fruits and roots of *S. persica* are salvadorin, dihydroisocoumarin, large amounts of chlorides, especially sodium and calcium, phosphorus, silicon, calcium oxalate, fluoride, silica; gypsum, saponins, resins, vitamin C, tannins, trimethylamine, β-sitosterol and m-anisic benzyl isothiocyanate, sodium bicarbonate, glycosides, organic compounds such as pyrrolidine, pyrrole, and piperidine derivatives. It has been reported that small amounts of tannins, saponins, sterols and flavonoids such as kaempferol, quercetin, quercetin glucosides, essential oil, linoleic acid, oleic acid and N-benzyl-2-phenylacetamide are effective on oral-dental health [58-63]. Additionally, knowing the phytochemical contents of *S. persica* is important for the field of oral-dental health.

3.5. Phytochemical contents

When the studies on *S. persica* were examined, it was seen that roots, twigs and leaves were generally used. It has been reported that *S. persica* contains benzyl isothiocyanate (33.32- 85.8%), benzyl nitrile (13.4-38.3%), benzaldehyde (0.5-4.7%), benzyl cyanide (16.26%), 1,8-cineol (46%), α-caryophellene (13.4%), β-pinene (6.3%), hydroxymethyl (12.56%), trimethylsilyl ester (I) (14.06%), trimethylsilyl ester (II) (27.17%), cyclohexanone (7.0%), 1-methoxy-4-(1-propenyl)-benzene (7.01%), butylated hydroxytoluene (34.66%), isothiocyanatomethyl-benzene (26.26%), thymol (2.08%), 2-methoxy-4-(2-propenyl)-

acetate (4.66%), cinnoline (2.51%), hexadecanoic acid (2.22%), octadecanoic acid (4.69%), phthalic acid, di(2-propylpentyl)-ester (6.24%), limonene (9.4%), α -pinene (8.7%), γ -sitosterol (25.76%), stigmaterol (5.92%), β -sitosterol acetate (2.28%), n-hexadecanoic acid (4.27%) and (z)-11-octadecenoic acid (3.16%) in the root sticks [23, 26, 29, 38, 44, 64-69]. It has been reported that *S. persica* contains (2E)-hexenal (32.7%), 1,8-cineol (0.79-20.8%), β -pinene (16.8%), α -pinene (5.9%), benzyl nitrile (53.96%), thymol (11.37%), isothymol (15.39%), eugenol (10.49%) and β -caryophyllene (4.72%) in its leaves [70-71]. Among the phytochemical contents in the root, twigs and leaves of *S. persica*, the most abundant compounds were found to be benzyl isothiocyanate, benzyl nitrile, trimethylsilyl-1,8-cineole, butylated hydroxytoluene, (isothiocyanatomethyl)-benzene, and (2E)-hexenal.

Table 2. Phytochemical contents of *Salvadora persica*

Used Parts	Phytochemical contents	Ref.
Roots, twigs	Benzyl isothiocyanate (33.32- 85.8%), benzyl nitrile (13.4-38.3%), benzaldehyde (0.5-4.7%), benzyl cyanide (16.26%), 1,8-cineole (46%), α -caryophellene (13.4%), β -pinene (6.3%), hydroxymethyl (12.56%), trimethylsilyl ester (I) (14.06%), trimethylsilyl ester (II) (27.17%), cyclohexanone (7.0%), benzene, 1-methoxy-4-(1-propenyl)-benzene (7.01%), butylated hydroxytoluene (34.66%), isothiocyanatomethyl-benzene (26.26%), thymol (2.08%), 2-methoxy-4-(2-propenyl)-acetate (4.66%), cinnoline (2.51%), hexadecanoic acid (2.22%), octadecanoic acid (4.69%), phthalic acid, di(2-propylpentyl)-ester (6.24%), limonene (9.4%), α -pinene (8.7%), γ -sitosterol (25.76%), stigmaterol (5.92%), β -sitosterol acetate (2.28%), n-hexadecanoic acid (4.27%), (z)-11-octadecenoic acid (3.16%)	[23,26, 29,38, 44,64-69]
Leaves	(2E)-hexenal (32.7%), 1,8-cineol (0.79-20.8%), β -pinene (16.8%), α -pinene (5.9%), benzyl nitrile (53.96%), thymol (11.37%), isothymol (15.39%), eugenol (10.49%), β -caryophyllene (4.72%)	[70-71]

4. Conclusions

The data presented in this review suggest that *S. persica* fruit can be used as a functional food to reduce nutrient deficiencies in vulnerable population groups or to enrich the content of processed foods. It also shows that *S. persica* can be investigated as a potential plant for nutraceutical, pharmacological and industrial uses. It has been observed that *S. persica* has antimicrobial, anti-inflammatory, antifungal, anticarcinogenic and cytotoxic properties and biological activities on oral health. It is thought that *S. persica* may be an important natural source of the compounds determined within it. When the advantages and disadvantages of *S. persica* are considered in all its aspects, it is recommended to use it as an important aid among other dental health products in oral and dental health.

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