A Review on The Medicinal Plants for The Management of Toothache in Avicenna's *Canon of Medicine*: An Evidence based Review

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**A B S T R A C T**

Toothache is one of the most popular pains which can influence the quality of life which generally refers to pain around the teeth or jaws. Avicenna (980–1032), a Persian scholar, made a great illustration about oral diseases and toothache in book three and the medicinal plants which used to relieve toothache in book two of *Canon of Medicine*. Current investigations show that most medicinal plants mentioned by Avicenna for the treatment of toothache could have significant potential effects, including anti-inflammatory, analgesic, anti-nociceptive, antimicrobial and anti-plaque activities, inhibition of the biofilm formation, and mechanical plaque control in the prevention of plaque and gingivitis. This study suggests that indigenous knowledge and traditional practice can make valuable contributions to the pharmaceutical industry and the production of new effects with less adverse effects drugs.

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Introduction

Pain is one of the most common medical challenges among the people globally and is hard to treat. People have almost always attempted to decrease or kill the pain [1]. Toothache is one of the most popular pains which can influence the quality of life [2] which generally refers to pain around the teeth or jaws. In most cases, toothaches are originated by tooth problems, such as a dental cavity, an exposed tooth root, a cracked tooth, or gum disease. The severity of a toothache could differ from chronic and mild to sharp and severe [3]. Today, drugs such as Analgesics, including non-steroidal anti-inflammatory drugs, opioids and corticosteroids, which are the most commonly used drug, antiulcer, antimicrobial and antibiotics, mouthwashes and multivitamins are applied to relieve this pain. (The aim of applying anti ulcers drugs was to prevent the side effects of Analgesics [3].) These available drugs have many side effects. On the other side, medicinal plants comprise important part of traditional medicine in many societies, and have a special place and value in modern therapeutic approaches [2]. Therefore, use of medicinal plants which have the prior choice to treat diseases could be an alternative therapy for different problems like toothache.

Persian medicine (PM) is one of the traditional systems of medicine that predates thousands of years ago [4]. It was developed during the Islamic golden age in the early medieval period. Many of the medical books of Persian doctors, such as Liber Regius (Royal Book or al-Maliki) of Haly, Liber Continent (al-Hawi) of Rhazes, and Canon (al-Qanun fi-Teb) of Avicenna were taught in western universities until the seventeenth century AD. Among the Persian physicians in the middle Ages, Avicenna (Ibn Sina, 980–1032 AD) was one of the most well-known and influential figures in the history of medicine. His knowledge of medicine, mainly what he had collected in his medical encyclopedia, the Canon of Medicine could be considered as an index of medical knowledge of his time [5]. So this review attempted to work on Avicenna’s Canon of Medicine and found Avicenna’s points of view about the toothache. In addition the information of Canon of Medicine was compared with current concepts of medicine to evaluate Avicenna knowledge status about 1000 years ago. Finally, the treatments mentioned by Avicenna to manage toothache were considered and the noticed medicinal plants were evaluated for approaches as possible sources for future studies. Some previous investigations discussed about dental and oral diseases in traditional PM [6,7], but it is the first study investigated comprehensively on all aspects of toothache in Canon of Medicine, specially focused on Avicenna’s views on treatments.

Study design

To find the medicinal plants which Avicenna recommended for toothache, the second book of the Canon of Medicine was reviewed [8]. He introduced all the Meteria Medica in PM in this book with their morphology, their temperament, general characteristics, and detailed properties in different parts of the body. Each plant was checked for its property in relieving toothache. 23 plants were noticed. The PM name, part used, mode of application, and temperament of each medicinal plants were collected. The information about the way of preparing and application of the plant was completed from the famous Persian Medicine Meteria Medica "Makhzan-ol-Adviah" [9]. Besides, scientific reports derived from modern medical databases like PubMed, Scirus, ScienceDirect, Google Scholar, and Scopus important added to PM information. All of the retrieved articles were published between 2000 and 2016, and any in vitro, in vivo, or clinical evidence for related efficacy and pharmacological mechanisms were considered for inclusion. The scientific name of medicinal plants, or its common name, with the key words include: toothache, oral problems, gingivitis, dental, analgesic, antinociceptive, anti-inflammatory, antibacterial, antimicrobial, plaque, anti-plaque, and biofilm were used to search for modern data. Only published articles written in English were included in this review. Those articles in languages other than English, review studies, papers that evaluated a mixture of the plant with drugs other than herbs, case reports, and case control studies were excluded. The references of the included papers were also reviewed for
additional, suitable studies. Finally, the included papers were reviewed for mention of the scientific names of the plant, their parts, as well as the active components and pharmacological effect.

**Traditional medicinal plants for toothache**

Avicenna's treatment views: it mentioned that toothache is originated from a problem in tooth nerve or in gum or infection in the teeth or gum. Each of these sources of pain has their own reasons and treatments. For example Avicenna said: if the patient feels beating pain, the main reason of toothache is in dental root and tooth nerve. The medicinal plants which are introduced by Canon of Medicine, book 2, are gathered in Table 1. For each plant data, including scientific name, family, Persian name, parts used, mode of application, and temperament were recorded in Table 1. The pharmacological effects of these plants, type of study, and active components also has been gathered in Table 2.

### Table 1. Medicinal plants mentioned in Canon of Medicine for managing toothache and their mode of application

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Family</th>
<th>Persian name</th>
<th>Parts used</th>
<th>Mode of application</th>
<th>Temperament*</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Cedrus libani</em> Barrel.</td>
<td>Pinaceae</td>
<td>Sherbin</td>
<td>Leaves</td>
<td>Mouthwash with vinegar and leaves decoction. Chewing</td>
<td>Hot, dry</td>
</tr>
<tr>
<td><em>Chelidonium majus</em> L.</td>
<td>Papaveraceae</td>
<td>Māmirān</td>
<td>Root</td>
<td>Chewing</td>
<td>Hot, dry</td>
</tr>
<tr>
<td><em>Citrus colocynthis</em> (L.) Schrad.</td>
<td>Cucurbitaceae</td>
<td>Hanzal</td>
<td>Root, fruit</td>
<td>To rinse (mouthwash) with the root decoction. Rubbing the oil on teeth Chewing</td>
<td>Hot, dry</td>
</tr>
<tr>
<td><em>Cnicus benedictus</em> L.</td>
<td>Asteraceae</td>
<td>Badaavar</td>
<td>Aerial parts</td>
<td>Gargling with the decoction of aerial part</td>
<td>Hot, dry</td>
</tr>
<tr>
<td><em>Cuperessus sp.</em> <em>Cuperessus sempervirens</em> L.</td>
<td>Cupressaceae</td>
<td>Sarw</td>
<td>Aerial parts</td>
<td>Gargling with the decoction of aerial part</td>
<td>Hot, dry</td>
</tr>
<tr>
<td><em>Curcuma longa</em> L.</td>
<td>Zingiberaceae</td>
<td>Orūqoṣeba ghin</td>
<td>Rhizome</td>
<td>Chewing</td>
<td>Hot, dry</td>
</tr>
<tr>
<td><em>Drimia maritima</em> (L.) Stearn</td>
<td>Asparagaceae</td>
<td>Eshgil</td>
<td>Root</td>
<td>Mouthwash</td>
<td>Hot, dry</td>
</tr>
<tr>
<td><em>Delphinium staphisagria</em> L.</td>
<td>Ranunculaceae</td>
<td>Mavizaj</td>
<td>Fuit</td>
<td>Mouthwash Gargling with the decoction, extract or its decoction with Syrian Rue and vinegar.</td>
<td>Hot, dry</td>
</tr>
<tr>
<td><em>Ecballium elaterium</em> (L.) A.Rich.</td>
<td>Cucurbitaceae</td>
<td>Ghesa ol Hemar</td>
<td>Root</td>
<td>Mouthwash Gargling with the decoction, extract or its decoction with Syrian Rue and vinegar.</td>
<td>Hot, dry</td>
</tr>
<tr>
<td><em>Hyoscyamus niger</em> L.</td>
<td>Solanaceae</td>
<td>Banj</td>
<td>Root, seed</td>
<td>The incense of seeds. To rinse (mouthwash) with the extract and root extract</td>
<td>Hot, dry</td>
</tr>
<tr>
<td><em>Iris jermanica</em> L.</td>
<td>Iridaceae</td>
<td>Irsā</td>
<td>Root</td>
<td>To rinse (mouthwash) with the root decoction</td>
<td>Hot, dry</td>
</tr>
<tr>
<td><em>Moringa peregrine</em> (Forssk.) fiori.</td>
<td>moringaceae</td>
<td>Baan</td>
<td>Root</td>
<td>To rinse (mouthwash) with the root decoction</td>
<td>Hot, dry</td>
</tr>
<tr>
<td><em>Nigella sativa</em> L.</td>
<td>Ranunculaceae</td>
<td>Shāniz</td>
<td>Seed</td>
<td>To rinse (mouthwash) with the seeds decoction</td>
<td>Hot, dry</td>
</tr>
</tbody>
</table>
### Continue of Table 1. Medicinal plants mentioned in *Canon of Medicine* for managing toothache and their mode of application

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Family</th>
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<th>Parts used</th>
<th>Mode of application</th>
<th>Temperament*</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Olea europaea</em> L.</td>
<td>Oleaceae</td>
<td>Zaytūn</td>
<td>Root, fruit, gum</td>
<td>To rinse (mouthwash) with the root extract. To rub (toothbrush) the fruit on teeth. To put the gum on dental caries</td>
<td>Hot, dry</td>
</tr>
<tr>
<td><em>Onopordum acanthium</em> L.</td>
<td>Asteraceae</td>
<td>shokaee</td>
<td>Arial parts Gum</td>
<td>Chewing</td>
<td>Hot, dry</td>
</tr>
<tr>
<td><em>Opopanax chironium</em> L.</td>
<td>Apiaceae</td>
<td>Jāvshīr</td>
<td>Root</td>
<td>To rub the gum on teeth or to fill dental caries</td>
<td>Hot, dry</td>
</tr>
<tr>
<td><em>Pinus orientalis</em> Link</td>
<td>Pinaceae</td>
<td>Şenobar</td>
<td>Bark</td>
<td>To rinse (mouthwash) with the bark extract with vinegar</td>
<td>Hot, dry</td>
</tr>
<tr>
<td><em>Plantago major</em> L.</td>
<td>Plantaginaceae</td>
<td>Lesan-ol-hamal Dolb</td>
<td>Root</td>
<td>To rinse (mouthwash) with the root decoction. Chewing the root</td>
<td>Cold, dry</td>
</tr>
<tr>
<td><em>Platanus orientalis</em> L.</td>
<td>Platanaceae</td>
<td></td>
<td>Bark</td>
<td>To rinse (mouthwash) with the decoction of bark and vinegar</td>
<td>Cold, dry</td>
</tr>
<tr>
<td><em>Rhus coriaria</em> L.</td>
<td>Anacardiaceae</td>
<td>Somaq</td>
<td>Seed, root</td>
<td>To rub (toothbrush) the powder of seeds on teeth. To put the gum on teeth</td>
<td>Cold, dry</td>
</tr>
<tr>
<td><em>Rumex conglomeratus</em> L.</td>
<td>Polygonaceae</td>
<td>Ḥammād</td>
<td>FruIt</td>
<td>To rinse (mouthwash) with the plant extract</td>
<td>Cold, dry</td>
</tr>
<tr>
<td><em>Solanum nigrum</em> L.</td>
<td>Solanaceae</td>
<td>‘Enabotha lab’ Athl</td>
<td>Leaf</td>
<td>To rinse (mouthwash) with the leaf extract</td>
<td>Cold, dry</td>
</tr>
<tr>
<td><em>Tamarix gallica</em> L.</td>
<td>Tamaricaceae</td>
<td></td>
<td>Aerial part</td>
<td>To rinse (mouthwash) with the aerial part extract</td>
<td>Cold, dry</td>
</tr>
</tbody>
</table>

*Entire world is made of quadratic elements and the diversities among objects derive from different ratios of these four elements used in their structures. This quality has been known as temperament (Midzaj).*

### Historical points of view

Mankind had suffered from toothache since the prehistoric era. In ancient Egypt, there are remedies for relieving this pain \[^{10}\]. Dental diseases have been mentioned in Sumerian records too. During late antiquity, oral care and even prosthetic dentistry gained better development in the Roman period \[^{1, 6}\]. Historically, the main available toothache treatment was restricted to medicinal plant preparations that were administrated to the gingival and mucosal tissues or used as mouthwashes \[^{10}\].

In PM, toothache was known as a main problem in oral cavity and it was attempted to realize the causes and treatment of it. In the *Canon of Medicine*, toothache is originated from a problem in tooth nerve or in gum or infection in the teeth or gum. Each of these sources of pain has their own reasons and treatments.

### Pharmacological mechanisms of action

The most common causes of a toothache are included, dental cavity, gum disease, tooth root sensitivities, and cracked tooth syndrome. Dental cavity is a condition where bacterial processes cause hard damage in to tooth structure leading to breakdown and producing dental caries. These bacteria are *Streptococcus mutans* and *Lactobacillus*. Gum disease refers to inflammation of the soft tissue and abnormal loss of bone that surrounds the teeth. It is caused by toxins secreted by certain bacteria in "plaque" which gather over time along and under the gum line.
This plaque is a mixture of food, saliva, and bacteria. Gingivitis, inflammation of the gum tissue, is described non-destructive periodontal disease that is almost caused by adhesion of bacterial biofilms (plaque) to tooth surfaces. Toothache could also be caused by exposing tooth roots due to the bacterial toxins which dissolve the bone around the roots and cause the gum and the bone to recede. In this condition the exposed roots can become exceedingly sensitive to cold, hot, and sour foods. Cracked tooth syndrome refers to tooth fracture without associated cavity or advanced gum disease that is most common in lower back teeth (molars). For these reasons of causing pain in teeth, different kinds of drug group are applied such as Analgesics, anti-inflammatory and antimicrobial and antibiotics. As seen in Table 2, many of the mentioned medicinal plants possess the above pharmacological properties. The medicinal plants which have noticed in section 2 of Canon of Medicine for relieving toothache were investigated in scientific reports derived from modern medical databases. The results showed that many of these plants have the potential to use as new pharmaceutical products for managing toothache due to their pharmacological effects, including anti-inflammatory, analgesic, and anti-nociceptive properties, antimicrobial and anti-plaque activities, inhibition of the biofilm formation, and mechanical plaque control in the prevention of plaque and gingivitis (Fig.1). 14 plants among 24 showed anti-inflammatory effect (58%) and 16 medicinal plants possess antimicrobial activity (66%). In the Canon of Medicine, Avicenna wrote that chewing the root of Chelidonium majus L. relieve toothache. New investigation showed this plant had Antibacterial [11-15], Anti-inflammatory [1, 4, 7, 16-19], and Analgesic activity [7, 20-24] activities. Curcuma longa L. (turmeric) had shown many pharmacological activities which can confirm its use as an effective medicinal plant for toothache. The rhizome that is prescribed to chew in the PM was revealed to have antibiofilm, antioxidant and activities against bacteria isolated from dental plaques and dental unit [25]. It had also shown antibacterial effect against the anaerobic bacteria isolated from the root canals of infected primary teeth, including Porphyromonas sp., Bacteroides fragilis, Peptostreptococcus, and Staphylococcus aureus [26]. Anti-plaque and anti-gingivitis properties of this plant had been shown in different articles [27-31, 38]. It had also revealed mechanical plaque control [30, 31] in the prevention of plaque and gingivitis [31] and reducing plaque index (PI) [29, 30], gingival index (GI), and probing depth (PD) [29]. Improvement of plaque index and gingival index scores from baseline through the end of the study was investigated through in vitro and in vivo study [32]. The plant antimicrobial property has been studied in various articles too [31, 33-37] and showed antibacterial activity against Enterococcus faecalis [33-35] in extracted teeth samples [33, 34], intracanal medicament in endodontic failure cases [35], inhibitory effect on the cariogenic properties of Streptococcus mutans and inhibit the formation of S. mutans biofilms [36]. Against Methicillin-resistant Staphylococcus aureus [37] reduce total microbial count [30]. The rhizome of turmeric had anti-inflammatory effect [29, 31, 38, 39, 40] which can cause toothache relief. It had exhibited treatment of gingivitis [39, 41], by reducing its inflammatory components [39], and periodontal pockets [32, 41]. Analgesic and antinociceptive effects were the other potencies of this medicinal plant which can apply for managing of toothache [40]. Nigella sativa L. (black cumin) is applied in Canon of medicine for toothache through rinsing (mouthwash) with the seed decoction. The seeds showed many effective pharmacological effects such as Anti-inflammatory [2-49], anti-nociceptive [50] analgesic [51, 52], antimicrobial [53, 54], a broad antimicrobial spectrum, including Gram-negative, Gram-positive bacteria, viruses, parasites, Schistosoma and fungi [53], antibacterial [55-57] properties. It also could inhibit the biofilm formation of S. aureus. The main active component of black cumin is Thymoquinone [44,46,47,50,52,53,55,57-61],
The Antibacterial \cite{62}, Anti-inflammatory \cite{63-66}, antinocepsive, and analgesic \cite{67} activities of *Olea europaea* L. can make it as an important medicinal plant to relieve toothache which had noticed in Avicenna’s manuscripts too. *Plantago major* L. that is applied in PM, rinsing (mouthwash) with the root decoction and chewing the root, has been showed antimicrobial activity \cite{68} against *Streptococcus mutans*, the main bacteria to produce dental caries \cite{69}, *Streptococcus pneumonia* \cite{70}, anti-inflammatory \cite{71}, cox-2 inhibitory, and antinocepsive effects \cite{72}. In addition, treating oral inflammation \cite{73}, Candida albicans biofilm-related infections \cite{74}, and oral wounds \cite{75} which were noticed in research articles can demonstrate its effectiveness in toothache relief.

**Table 2.** The list of medicinal plants by Avicenna for managing toothache and their current pharmacological effects.

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Family</th>
<th>Persia name</th>
<th>Pharmacological effect</th>
<th>Type of study</th>
<th>Active components</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Cedrus libani</em></td>
<td>Pinaceae</td>
<td>Sherbin</td>
<td>Anti-inflammatory activity \cite{76}, antibacterial efficacy against <em>Bacillus megaterium, B. subtilis, B. cereus, Klebsiella pneumonia, Enterobacter aerogenes, Staphylococcus aureus, Mycobacterium smegmatis, Proteus vulgaris, Listeria monocytogenes, Pseudomonas aeruginosa</em> activity \cite{77}</td>
<td>In vivo \cite{76} in vitro \cite{77,78}</td>
<td>- \cite{76-78}</td>
</tr>
</tbody>
</table>
**Continue of Table 2.** The list of medicinal plants by Avicenna for managing toothache and their current pharmacological effects.

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<th>Pharmacological effect</th>
<th>Type of study</th>
<th>Active components</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Citrullus colocynthis</em> (L.) Schrad.</td>
<td>Cucurbitaceae</td>
<td>Ḥanżal</td>
<td>Analgesic and anti-inflammatory activities [79,80], Antimicrobial activities against foodborne bacteria [81] <em>Pseudomonas aeruginosa</em> [82], Treatment of toothache [83]</td>
<td>In vivo [79,80]</td>
<td>4-Methylquinoline [81]</td>
</tr>
</tbody>
</table>
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<table>
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</thead>
<tbody>
<tr>
<td><em>Cupressus sp.</em></td>
<td>Cupressaceae</td>
<td><em>Sarw</em></td>
<td>Antimicrobial (against <em>Klebsiella pneumoniae</em>) and antibiofilm properties (<em>Cupressus sempervirens</em>) [84] Reduce the rate of dental plaque formation by decreasing the virulence of these periodontophathic bacteria (<em>Cupressus hisitanica</em> [85])</td>
<td>In vitro [84] In vitro [85]</td>
<td>--- [84] tannic acid [85]</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
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<th>Pharmacological effect</th>
<th>Type of study</th>
<th>Active components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyoscyamus niger L.</td>
<td>Solanaceae</td>
<td>Banj</td>
<td>Analgesic [90,91] on acute and chronic pain thresholds [91], Anti-inflammatory (both acute and chronic inflammation) and antipyretic activities [90] treatment of toothache [92,93]</td>
<td>In vivo [90,91] Historical use [92,93] In vitro [94]</td>
<td>cleomiscosin A (coumarinolignan) [90] -- [94]</td>
</tr>
<tr>
<td>Moringa peregrina (Forssk.) Fiori</td>
<td>moringaceae</td>
<td>Baan</td>
<td>Antimicrobial activity against Staphylococcus aureus, S. epidermidis, Pseudomonas aeruginosa, Escherichia coli, Enterobacter cloaceae, Klebsiella pneumoniae, Candida albicans, C. tropicalis and C. glabrata [99]</td>
<td>In vitro [99]</td>
<td>-- [99]</td>
</tr>
</tbody>
</table>
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<table>
<thead>
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<th>Scientific name</th>
<th>Family</th>
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<th>Pharmacological effect</th>
<th>Type of study</th>
<th>Active components</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Olea europaea</em> L.</td>
<td>Oleaceae</td>
<td>Zaytūn</td>
<td>Gram-negative, anaerobic periodontal pathogens such as <em>Porphyromonas gingivalis</em>, <em>Prevotella intermedia</em>, and <em>Fusobacterium nucleatum</em> (oral pathogens) [62]. Anti-inflammatory [63-65] and analgesic [67].</td>
<td>In vitro [62,64-66,75], In vivo [64,67], Human study [63]</td>
<td>Unsaponifiable fraction [63] maslinic acid [64] nocellaralactone [65], oleocanthal[66]</td>
</tr>
<tr>
<td><em>Onopordum acanthium</em> L.</td>
<td>Asteraceae</td>
<td>shokaee</td>
<td>Anti-inflammatory effect, inhibition of cyclooxygenase-2 [101]</td>
<td>In vitro [101]</td>
<td>Lignans, flavonoids, and sesquiterpenes, 4β,15-Dihydro-3-dehydrozaluzanin C and zaluzanin C [101]</td>
</tr>
<tr>
<td><em>Plantago major</em> L.</td>
<td>Plantaginaceae</td>
<td>Lesan-ol-ḥamal</td>
<td>Antimicrobial activity [68] against <em>Streptococcus mutans</em> [69], <em>Streptococcus pneumonia</em> [70]. Anti-inflammatory [71]. Treatment of oral inflammation [73] treatment of Candida albicans biofilm-related infections [74], Oral wound healing properties [75], Anti-nociceptive [72], Anti-inflammatory effect [102] and analgesic [102,103]</td>
<td>In vitro [68,69,74,75], In vivo [70-72] historic al use [73]</td>
<td>--- [68,69,71-73,75], aucubin, and baicalein [74], alpha-linolenic acid and -(Z)-5-thia-8,11,14,17-eicosatetraenoic acid [71] pectin polysaccharide, PMII [76]</td>
</tr>
<tr>
<td><em>Platanus orientalis</em> L.</td>
<td>Platanaceae</td>
<td>Dolb</td>
<td>Anti-inflammatory [102,103]</td>
<td>In vivo [102,103]</td>
<td>--[102,103]</td>
</tr>
<tr>
<td><em>Rhus coriaria</em> L.</td>
<td>Anacardiaceae</td>
<td>Somaq</td>
<td>Antimicrobial effect [105] against five common oral bacteria, inhibit bacterial biofilm formation [105] against <em>Streptococcus mutans</em>, <em>Lactobacillus rhamnosus</em> and <em>Actinomyces viscosus</em> [106]. Analytical effect [104]</td>
<td>In vitro [105,106], In vivo [104]</td>
<td>--[105,106], Favonoids [104]</td>
</tr>
</tbody>
</table>
Discussion
In Persian Pharmacy there were different and board ways of drug application for oral and dental problems. The most popular routes of administration in the oral cavity or particularly teeth were rinsing or mouthwash (madmadat), gargling (gargharah), toothbrush (meswak), rubbing on teeth (sanūn), chewing (madgh), sprinkling on teeth (dharūr), inhaling incense (bakhūr), and to apply directly on the teeth. All of these routes are topical and used in the oral cavity to affect the teeth, gum, and nerves. There are a few occasions in which the formulation should be drunk and act systematically to relieve toothache. Among these routes of administration, rinsing or mouthwash was the most common (44%), followed by rubbing or toothbrush and chewing (17%). 69 preparations are applied externally in the form of decoction [12], crude part of a plant [17], extract [18], powder [15], and oil [13], whereas one is taken orally in the form of an extract. In 10 prescriptions, vinegar accompanied the medicinal plant in the mixture. Vinegar in PM is a well-known materia medica and has an important role in traditional pharmacy. It is an astringent and desiccating agent in PM possessing rapid penetrating properties and accelerates reach of accompanying medicine to its target organ [16-20]. Consequently, it is used in some of drug formulations in this review to accelerate drug penetration in different parts of the body.
The philosophy of PM is based on quadratic elements. These elements are air, fire, water, and soil with specific qualities. For example, fire is hot and dry, the air is hot and moist, water is cold and moist, and soil is cold and dry. Followers of this ideology believe that the entire world is made of quadratic elements and the diversities among objects derive from different ratios of these four elements used in their structures. This quality has been known as temperament (Midzaf). Theory of temperament also existed in many other traditional medical theories, including Chinese, Greek (Unani), Indian, Arabic, Roman, and European [19]. Based on this theory, the temperament of choosed ethnomedicinal plants was collected. The majority of traditional medicinal plants in this study had “hot, dry” temperament (78%) and then “cold, dry” (22%). According to PM theory the temperament of tooth is dry, so the drugs used for treatment should be dry, too. The heat or the cold of drugs is determined by the cause of disease which reverses the cold or heat of the disease [24]. In PM there are some plants which are mentioned as harmful for teeth or can cause toothache such as Raphanus sativus L. (radish), Vigna mungo (L.) Hepper. (black gram), Juglans regia L. (walnut), Phoenix dactylifera L. (date), Ficus carica L. (fig), and Allium ampelopersum L. (leek) [16-20]. These medicinal plants could be avoided during the period of suffering from toothache.

Conclusion
Results obtained from this review showed that several plants have been applied in Canon of Medicine for relieving toothache. Recent investigations support the claims of the PM about the efficacy of many of these plants, including Cedrus libani, Chelidonium majus, Citrullus colocynthis. Cuperessus sempervirens, Curcuma longa, Ecballium elaterium, Hyoscyamus niger, Iris jermanica, moringa peregrine, Nigella sativa, Olea europaea, Onopordum acanthium, Plantago major, Platanus orientalis, Rhus coriaria, Solanum nigrum, and Tamarix gallica.
For some of the herbal products used in PM, such as Cnicus benedictus, Drimia maritime, Delphinium staphisagria, Opopanax chironium, Pinus orientalis, and Rumex conglomeratus, there are no (or not enough) studies to confirm their properties to manage toothache. These plants could be studied for their pharmacological potencies in controlling this pain or treating toothache.
In current years, there was a great interest in herbal and traditional medicine for the management and treatment of a variety of diseases. These studies suggest that indigenous knowledge and traditional practice can make valuable contributions to the pharmaceutical industry and the production of new effects with less adverse effects drugs.
Conflict of interest

Authors certify that there is no actual or potential conflict of interest in relation to this article.

References


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