

Use of herbs and medicinal plants in dentistry: a review

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Objectives This study reviews herbs and medicinal plants in dentistry and discusses their biological activities, benefits and side effects. **Review of Literature** In this review, the PubMed, Medline and Google Scholar databases were electronically searched for relevant articles and books in English using the keywords “medicinal plant”, “herb”, “phytotherapy”, “dentistry” and “pediatric”. **Conclusion** Medicinal herbs have long been an inseparable part of treatment of various diseases. Today, the range of applications of these plants is not limited to medical treatment and various types of medicinal plants are used in various fields including dentistry. Increased interest in medicinal plants is mainly due to less side effects compared to those of synthetic drugs and they are often favored for use in children. **Keywords** plants, medicinal, phytotherapy, pediatric dentistry

Introduction

The use of medicinal plants has a long history in medical and dental practice and they have long been used worldwide.¹ Anti-inflammatory, antibacterial and antioxidant properties of plants as well as their biocompatibility explain the people's growing interest in the use of herbal medications.²

Today, more than 90% of school children and a large proportion of adults have dental caries in many parts of the world.³ This indicates the need for improved diagnostic and therapeutic procedures in dentistry, especially in children. On the other hand, misuse and overuse of antibiotics are increasing.¹ Use of synthetic drugs, especially in children, can have adverse effects such as liver complications.⁴ A study conducted on irrigating solutions showed that chlorhexidine (CHX) causes tooth discoloration, creates a burning sensation in the mouth and results in loss of taste.⁵ Sodium hypochlorite can cause allergy and tissue toxicity and calcium hydroxide cannot efficiently remove bacteria from the dentinal tubules.^{2,6,7} Moreover, not all people have access to synthetic drugs and thus, they may use herbal medicines as alternatives. Evidence shows that 65–80% of people in developing countries use medicinal plants for their treatment.⁸ In 2007, a study conducted in the United States showed that 12% of children in the US used alternative medicine, and 5% used plant-based treatments.⁹ Many people also prefer herbal remedies, and ask for guidance and advice in this regard from their physicians.¹⁰

Since different plants have different compositions and effects, we aimed to review a number of medicinal plants used in dentistry, especially pediatric dentistry, and discuss their benefits and side-effects to promote proper use of medicinal herbs in treatment of oral conditions in children.

Materials and Methods

The PubMed, Medline and Google Scholar databases were electronically searched for relevant articles and books published in English using the keywords “medicinal plant”, “herb”, “phytotherapy”, “dentistry” and “pediatric”.

Overview of the Use of Plants in Dentistry

Before the main discussion, we provide an overview of the use of plants in various fields of dentistry. For example, in periodontics, aloe vera (medicinal aloe) is used for reducing gingival bleeding and gingival inflammation,^{11,12} *Azadirachta indica* (neem) is used for reducing plaque index,¹³ *Pistacia atlantica* (mastic tree) is used for its activity against gingival microorganisms¹⁴ and *Salvadora persica* (mustard tree) is used for improving gingival health.¹⁵

In endodontics, *Camellia sinensis* (green tea),⁶ *Morinda citrifolia* (Indian mulberry)¹⁶ and propolis¹⁷ can be used as irrigating solutions. For pulp capping, propolis can be named.¹⁸ Plants that have been studied as intracanal medicaments include *Arctium lappa* (greater burdock),¹⁹ *Curcuma longa* (turmeric) can be used for endodontic retreatment for dissolving and softening of gutta-percha.²⁰

In oral and maxillofacial surgery, Ankaferd Blood Stopper® made of *Glycyrrhiza glabra* (licorice), *Vitis vinifera* (grape vine), *Alpinia officinarum* (lesser galangal), *Thymus vulgaris* (common) and *Urtica dioica* (common nettle) can be used to decrease bleeding and SaliCept patch made of aloe vera can be used to decrease the incidence of alveolar osteitis.²¹

Various types of lesions can occur in the mouth. In order to find a cure for them, various medicinal plants have been studied. For example, for the treatment of aphthous ulcers, aloe vera can accelerate healing of ulcers and reduce pain.²² For the treatment of viral lesions such as herpetic lesions, *Melissa officinalis* (lemon balm) can be used to decrease cytopathic effect of herpes simplex virus (HSV) type II²³ and *Mentha piperita* (peppermint) can be used for its high virucidal activity against HSV-1 and HSV-2.²⁴ For treatment of *Candida albicans*, *Coriandrum sativum* (coriander) can be used.²⁵ For the treatment of lichen planus, aloe vera²⁶ and *Portulaca oleracea* (little hogweed) can be named.²⁷

Plants are the basis of many dental materials. For example, *Cinnamomum camphora* (camphor tree) is used in camphorated monochlorophenol, an intracanal medicament; *Gelidium amansii* (agar agar) is used in agar impression material, *Laminariadigitata* (Oarweed) is used in alginate impression material, *Syzygium*

aromaticum (clove) is used in zinc oxide eugenol cement endodontic sealer, Citrus limon (lemon) is used in citric acid periodontal root conditioning and *Palaquium gutta* is used in gutta-percha endodontic filling material.²¹

Table 1 presents an overview of a number of plants used in dentistry and their biological properties.

Phytotherapy in Pediatric Dentistry

Since many people believe that medicinal plants are safer than invasive methods and chemical drugs and have fewer side effects, the tendency to use medicinal plants for children has increased. Some of the properties of plants used for this purpose are reviewed.

Prevention of Dental Caries

High rates of decay besides the high costs of treatment highlight the need for caries prevention. For this reason, the use of anti-bacterial materials and fluoride-containing substances is important. Studies have shown that some plants can increase the sensitivity of microorganisms by using secondary metabolites. Moreover, some of them can inhibit bacterial growth and their acid production, inhibit the adhesion of bacteria to the teeth and inhibit the synthesis of exopolysaccharide for prevention of dental decay.⁶²⁻⁶⁴ For example, some of these plants are mentioned below:

1. *Allium sativum* (garlic): Garlic reinforces the immune system, reduces blood pressure and decreases cholesterol synthesis in the liver. This plant can be used for

treatment of asthma, arthritis, atherosclerosis and circulatory and digestive problems. Its fresh oil, raw cloves and odorless extract are used.^{20,30} Research shows that allacin is responsible for its antibacterial properties. The plant inhibits the growth of *Streptococcus mutans* and reduces its acid production. It also increases the secretion of saliva and can be effective for prevention and treatment of dental caries.^{32,65}

2. *Azadirachta indica*: Neem reduces the frequency of early caries and reverses its process to the same extent as chlorhexidine by decreasing the count of *Streptococcus mutans*.²¹ It has antibacterial properties and is a biocompatible antioxidant. It is effective against *Enterococcus faecalis* and *Candida albicans*.³⁷ It has been shown that this plant can inhibit the growth of *Streptococcus mutans*, *Streptococcus mitis*, *Streptococcus sanguinis* and *Streptococcus salivarius*.⁶⁶ In another study, it was shown that the gel containing neem significantly decreased the plaque index and bacterial count.¹³
3. *Camelliasinensis*: Green tea is anti-cancer,⁶⁷ anti-oxidant, anti-inflammatory and free radical inhibitor. It is considered to be safe.⁴³ Due to its disinfectant and deodorant activities, green tea can also be effective in reducing oral malodor.⁶⁸ It has antimicrobial properties via inhibition of gyrase enzyme.⁶⁹ Flavonoids found in it cause antibacterial activity against cariogenic bacteria. It contains fluoride that is effective in preventing cavities.⁶ Miller et al. showed that compounds of these plants, especially

Table 1. Biological activities of medicinal plants

Herbs	Biological activities	Herbs	Biological activities
<i>Allium sativum</i> ^{20,30-32}	Antibiotic, antibacterial, antifungal, hypotensive, antithrombotic, immune regulatory function, hypocholesterolemic, anti-caries	<i>Melaleuca alternifolia</i> (tea-tree) ^{28,29}	Antibacterial, antifungal, anti-inflammatory
<i>Aloe vera</i> ^{26,34,35}	Antibacterial, antioxidant, antifungal, antiviral, anti-inflammatory	<i>Melissa officinalis</i> ^{23,33}	Sedative, anxiolytic, hypnotic, antiviral
<i>Arctium lappa</i> ¹⁹	Antibacterial, antifungal, diuretic, antioxidant, anxiolytic, platelet anti-aggregating, HIV-inhibitory action	<i>Morinda citrifolia</i> ¹⁶	Antimicrobial
<i>Azadirachta indica</i>	Antioxidant, antifungal, antibacterial, antimicrobial	<i>Passiflora incarnate</i> ³⁶	Sedative, anxiolytic
<i>Camellia sinensis</i> ⁴⁰⁻⁴³	Antimicrobial, antibacterial, anti-cariogenic, antioxidant, anti-inflammatory	<i>Propolis</i> ^{38,39}	Antimicrobial, cytostatic, antioxidants, anesthetic, anti-inflammatory, antifungal, Antibacterial, antiviral, anti-carcinogenic, antithrombotic, immunomodulatory
<i>Carum carvi</i> ²⁵	Antihistaminic, antiseptic, antimicrobial, expectorant, spasmolytic, diuretic	<i>Punica granatam</i> (pomegranate) ⁴⁴	Antibacterial
<i>Citrus aurantium</i> (orange) ^{47,48}	Antimicrobial	<i>Ricinus communis</i> (castor bean) ⁴⁶	Antimicrobial
<i>Commiphora</i>	Antiseptic	<i>Rosmarinus officinalis</i> (Rosemary) ⁴⁹	Antibacterial, antifungal
<i>Coriandrum</i>	Antifungal	<i>Sanguinaria canadensis</i> ^{51,52}	Antibacterial, antiplaque
<i>Echinacea</i> ⁵⁴	Stimulates immune response	<i>Salvadora persica</i> ⁵³	Antimicrobial
<i>Equisetum</i> ⁵⁵	anti-inflammatory, antipyretic, anti-bleeding	<i>Salvia officinalis</i> ⁴⁵	Anti-inflammatory, antibacterial, antifungal, antiviral
<i>Matricaria chamomilla</i> ³⁶	Anti-inflammatory	<i>Syzygium aromaticum</i> ^{56,57}	Antioxidants, antibacterial, anodyne effect, anti-cariogenic
<i>Mentha piperita</i> ^{45,59-61}	Carminative, analgesic, antimicrobial, muscle-relaxing action	<i>Valeriana officinalis</i> ^{36,58}	Tranquilizing and sedative

simple catechins in it, are responsible for anti-cariogenic properties of this plant. For example, it has anti-bacterial effects against *S. mutans*, *S. salivarius* and *E. coli*,⁷⁰ it inhibits adhesion of bacteria to tooth by inhibition of glucosyl transferase and inhibits sticky glucan biosynthesis and also bacterial and human amylase enzyme. Some studies have shown that regular consumption of tea can effectively decrease the incidence and severity of dental caries.⁴²

4. *Curcuma longa*: Turmeric is antioxidant, anti-inflammatory and antimutagenic. Its mouthwash causes a rapid reduction of pain. When rubbed on the aching tooth, it relieves pain. The paste contains turmeric, mustard and salt and is useful for reducing gingivitis and periodontitis.⁵⁵ Turmeric has strong antibacterial properties against *S. mutans* biofilm and is as effective as CHX. So it can be effective in preventing dental caries.²¹
5. *Mentha piperita*: In the past, peppermint used to treat stomach, intestinal and muscle conditions and improve blood circulation. Today, it is also used to treat conditions such as colic, fever, nausea and diarrhea. Menthol and methyl acetate are among its other constituents. In dentistry, it can be applied topically to relieve dental pain, and as mouthwash for reducing inflammation of the gums.⁵⁵ In one study, the antimicrobial activity of *M. piperita* and *Rosmarinus officinalis* essential oils and CHX against *S. mutans* and *Streptococcus pyogenes* was investigated; the results showed that the antimicrobial activity of peppermint was good.⁶⁰ Another study showed that its oil locally had virucidal properties against herpes simplex viruses (HSV-1 and HSV-2).²⁴
6. *Pistacia atlantica*: This plant is from *Pistacia* species. Different parts of the plant including resin, leaves, fruit, and aerial part can be used for therapeutic purposes. For example, its resin, which is also known in Iran as Saqqez, can be used as mouth freshener, antiseptic and gum tissue strengthener and is available in the form of chewing gum for gastrointestinal disorders, and motion sickness treatment.^{71,72} Its constituents include α -pinene and terpenoids. In one study, it was shown that mouthwash containing this plant can act effectively against gingival microorganisms.¹⁴ Another study showed that this plant extract can have antibacterial effects on *S. mutans* and *S. mitis*.⁷³
7. *Propolis*: This resin mixture is collected by honeybees from plant sources.³¹ It has antimicrobial, anti-inflammatory, healing, anesthetic, cytostatic and cariostatic properties and can also improve the immune system.⁷⁴ A study showed that *Propolis* can effectively decrease plaque accumulation.⁷⁵ Other studies have shown that *Propolis* can interfere in growth and adhesion of *S. mutans* and its glucosyl transferase activity. Thus, it has anti-caries properties. It is worth mentioning that more studies are needed to assess the quality and safety of the substance.⁷⁶ Due to its antimicrobial properties against *E. faecalis*, studies evaluated its efficacy in endodontic treatment as irrigant and intracanal medication.^{2,16} It also has potential for use as pulp-capping agent.¹⁸ It is available in various forms such as tablet, gel and mouthwash.⁷⁷
8. *Syzygium aromaticum*: Clove has antiseptic, antioxidant and antiemetic properties. It can be used for treatment of

oral, pulmonary, gastrointestinal and blood circulation problems. Chewing clove reduces bad breath. Rubbing the oil on the gums and teeth can reduce pain.^{55,56} Its extract can reduce water-insoluble glucan synthesis and thus can have anti-caries property.⁵⁷

Storage Media for Avulsed Teeth

In case of occurrence of avulsion, it is important to use a suitable storage medium for the avulsed tooth until its replantation in dental office. Some of these media include milk, saliva, and Hank's balanced salt solution (HBSS).^{78,79} Some plants can be used for preparation of such media as follows:

1. *Camellia sinensis*: Green tea extract can be used as a storage medium for avulsed teeth. It has been as efficient as the HBSS for keeping PDL cells alive.⁶⁷
2. *Cocos nucifera* (coconut): one study showed that skimmed and whole milk, followed by natural coconut water and HBSS were effective for keeping PDL fibroblasts viable.⁸⁰
3. *Morus rubra* (red mulberry): Studies have shown that the juice of red mulberry with concentration of 2.5% and 4% had superior efficacy compared to HBSS at 3, 6, and 12 hours. Its 4% extract had equal efficacy to HBSS at 24 hours. Thus, it is suitable as a medium.⁸¹
4. *Salvia officinalis* (garden sage): Its constituents include alpha and beta-thujone, camphor, cineole, rosmarinic acid, tannins and flavonoids. In modern herbal medicine in Europe, this plant is recommended for treatment of sore throat, inflammation of the gums and mouth. Its oil has antibacterial, antifungal, and antiviral properties.⁴⁵ The extract can be used as storage medium. This medium can maintain the viability of the periodontal ligament of the avulsed tooth and its 2.5% concentration is the most effective.⁸² Sage and chamomile tea can be used before dental treatment to reduce stress.⁵⁵
5. *Propolis*: *In vitro* studies on dogs have shown that the survival rate of PDL cells in *propolis* is similar to milk. Another study showed that it was appropriate to keep the avulsed tooth in *propolis*, as a medium, for up to 6 hours.⁸³

Endodontic Treatment in Primary Teeth

In many cases, the primary teeth should be maintained during the primary and mixed dentition period for the purpose of space maintenance. Also, preserving the integrity of primary teeth is important for development of permanent teeth.^{84,85}

Endodontic treatment is the last option to maintain the primary teeth. Zinc oxide eugenol, iodoform-based pastes and calcium hydroxide can be used for endodontic treatment of primary teeth.⁸⁶ Vital pulpotomy is another modality, which involves applying a medicament over the residual radicular pulp tissue to promote healing.⁸⁷ Formocresol, calcium hydroxide, glutaraldehyde, enriched collagen solution, ferric sulfate and mineral trioxide aggregate can be used for pulpotomy.⁸⁸

A study showed that using a mixture of zinc oxide powder and aloe vera gel for endodontic treatment of primary teeth yielded good clinical and radiographic success.⁸⁶ Another study showed that propolis and mineral trioxide aggregate are more biocompatible than formocresol and ferric sulfate.⁸⁹ In vital pulpotomy of primary molar, it was seen that formocresol and Ankaferd Blood Stopper® were successful as pulp dressing in primary molars at 12-month follow-up.⁹⁰ It has been shown

that *A. sativum* oil has stronger effects than formocresol on the infected pulp of primary non-vital molars.⁹¹ Of course, more research is needed in this area.

Oral Mouth Rinse

Mouthwashes are efficient and convenient for use to improve oral hygiene. *Salvia officinalis*, *M. piperita*, menthol, *Matricaria chamomilla* (chamomile), *Commiphora myrrha* (myrrh), *Carum carvi* (caraway seed), *S. aromaticum* and *Echinacea purpurea* (purple coneflowers)⁹⁴ are plant compounds that can be used as mouth rinse to reduce gingival index.⁹²

The following plants are also used in mouth rinses. It should be noted that each of these oral rinses has therapeutic

effects as well as side effects of its own: *Aloe vera*,^{12,35} *A. indica*,²¹ *C. longa*,⁵⁵ *Echinacea*,⁵⁴ *M. chamomilla*,⁹³ *M. piperita*,⁹⁴ *Pistacia atlantica*,¹⁴ *propolis*,⁷⁷ *Sanguinaria canadensis*,^{95,96} *S. officinalis*,⁹⁷ *S. persica*,¹⁵ *C. carvi*, *C. myrrha*, *Stellaria media* (chickweed), *Sambucus* (elderberry), *Hydrastis canadensis* (goldenseal), *Equisetum* (horsetail), *Calendula officinalis* (common marigold), violet, *Achillea millefolium* (yarrow).⁴⁵

Sedative and Anti-anxiety Activity

Control and reduction of fear and anxiety in patients is one of the most important points that dentists should consider in their practice. This is especially important in children. Chemical

Table 2. Constituents of medicinal plants

Constituents	Properties	Example
Alkaloids	Analgesic	Indian mulberry
Allicin	Antibacterial	Garlic
Antraquinine	Antibacterial	Aloe vera
Carotenoids	Antimicrobial, antioxidant	Orange
Catechins	Antimicrobial	Indian mulberry
Flavonoids	Antioxidant, anticancer, anti-inflammatory, antiviral	Green tea, Indian mulberry
Fluoride	Cavity prevention	Green tea
Phenols	Analgesic, antimicrobial, anti-inflammatory	Thyme
Tannins	Anti-inflammatory, antimicrobial	Sage
Terpenoids and Essential oils	Antimicrobial	Indian mulberry

Table 3. Adverse effects of medicinal plants

Herbs	Adverse effects
1. <i>Allium sativum</i> ¹⁰⁴	Contact dermatitis
2. <i>Carum carvi</i> ⁴⁵	Avoid using it in children under 2 years old; skin and mucosal membrane irritation if accompanied by Umbelliferae family
3. <i>Echinacea</i> ^{104,105}	Allergic reactions, gastrointestinal discomfort
4. <i>Melaleuca alternifolia</i> ¹⁰⁴	Contact dermatitis
5. <i>Matricaria chamomilla</i> ^{106,107}	Allergic conjunctivitis, interaction with warfarin
6. <i>Mentha piperita</i> ^{45,94,108}	Burning sensation and gastrointestinal upset, interferes with iron absorption; avoid applying its oil on face in children and infants.
7. <i>Melissa officinalis</i> ^{33,104}	Contact dermatitis, diarrhea, nausea, elevated intraocular pressure, sleep disorders, headache, fatigue, synergistic effect with alcohol and barbiturates
8. <i>Passiflora incarnate</i> ^{36,109}	Vasculitis in insomnia patients; use with caution with CNS depressants, phenelzine and stimulants
9. <i>Pistacia atlantica</i> ¹¹⁰	Cytotoxic/genotoxic effects
10. <i>Sanguinaria Canadensis</i> ^{45,111}	Leukoplakia, diarrhea, stomach pain, distorted vision, paralysis, fainting, edema, glaucoma, heart disease, miscarriage, unsafe in children and pregnant or lactating women
11. <i>Ricinus communis</i> ¹¹²⁻¹¹⁴	Asthma, contact dermatitis, laxative effect, nausea, vomiting, colic
12. <i>Rosmarinus officinalis</i> ⁴⁵	Avoid during pregnancy, iron deficiency
13. <i>Thymus vulgaris</i> ⁴⁵	Skin and mucous membrane sensitivity, dizziness, vomiting, spasmodic cough especially in young children
14. <i>V. officinalis</i> ^{36,115}	Gastrointestinal discomfort, dizziness, headache, extra-sedation, interaction with sedatives

agents such as oral benzodiazepines and nitrous oxide-oxygen inhalation are used for this purpose.⁹⁸

Plants with sedative and anti-anxiety properties include *Melissa officinalis*,³³ *Passiflora incarnata* (purple passionflower)³⁶ and *V. officinalis* (valerian).⁵⁸ More studies are needed on their use in dentistry.

Constituents of Plants used in Dentistry

Several studies have been done on the molecular structure of plants. However, due to their complex structure, it is difficult to explain the precise molecular mechanisms behind their properties. Table 2 shows some of the constituents of medicinal plants and some of their properties.^{6,20,21,45,99,100}

Adverse Effects

Side effects and toxicity of medicinal plants can be discussed in general, and specifically for each plant and depend on factors such as their chemical composition, contaminants and adulterants. Also, some plants can have synergistic effects on each other. One of the important points is how plants are named in different geographic areas; this means that a plant can have different names in different regions, which can cause a lot of problems.^{101,102}

Another point is the concentration of active components in a plant, which can vary based on part of the plant used, the harvesting time of plant, weather and soil conditions. That makes the dose of active components variable and unpredictable. This

is more important in children because of their small body size and lower capacity of detoxification. It is important to note that children are different from adults in absorption, digestion, metabolism and excretion of substances. On the other hand, since their liver is still developing, they have different detoxification capacity compared to adults. Thus, it is important to assess the side effects and toxicity of plants for use in children.¹⁰³ Table 3 summarizes some of the side effects of herbs and their interactions with synthetic drugs.

Conclusion

Due to the side effects and disadvantages of synthetic drugs, the use of medicinal plants is increasing considering their low cost, availability and biocompatibility. Further studies on types of suitable medicinal plants, their use and dosage are required especially in children to know more about their toxicity and possible side effects.

Acknowledgment

None.

Conflict of Interest

None. n

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