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Review Article

Medicinal Plants for the Treatment and Management of Oral Infections: A Review

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ABSTRACT

Herbal medicines have been utilized to treat a variety of ailments since antiquity. One of the most important areas of research for reducing oral infection consequences is the natural sources. As a result of the introduction of chemical medications, the use of herbal medicine has diminished. This review was aimed at highlighting the various medicinal plants that are useful in the prevention and management of oral infections. An internet search using search engines such as Google, Google Scholar, Research Gate, PubMed, and Science Direct was conducted among published articles from 2011 to 2020. The keywords used for the search were oral infections, herbal medicine, gingivitis, oral herpes, and oral thrush. In this review, the medicinal plants used in the treatment and management of gingivitis, oral herpes, oral thrush, and tooth decay are presented in four categories as a result of the search. This current study has revealed that herbal medicine is an excellent complementary/alternative therapy for a variety of oral disorders. As a result, future phytochemical and pharmaceutical investigations should focus on often reported therapeutic plants in order to develop natural medications are both effective and free of adverse effects in the treatment of oral infections.

Keywords: Medicinal plants, Oral infections, Dental decay, Gingivitis, Oral herpes, Oral thrush.

Introduction

The World Health Organization (2012) described oral health as a condition of being free of mouth and facial pain, oral infections, sores, and other oral disorders that impede a person's ability to bite, eat, smile, talk, and maintain psychological well-being.[1]It is crucial for overall health and good quality of life. Tooth loss from poor periodontal health (which affects up to 20 % of the adult population worldwide) can cause considerable morbidity and even mortality. Oral diseases have a significant economic impact, with curative dental treatment accounting for up to 10 % of public health spending in affluent countries.[2,3] During the last two decades, the link between oral and overall health has been more apparent. According to several epidemiological studies, poor oral health has been associated with cardiovascular diseases, poor glycemic control in diabetic patients, low birth weight of pre-term babies, and a variety of other illnesses. These illnesses include rheumatoid arthritis and osteoporosis.[4] Of foundational importance are oral disease prevention and oral health promotion. Traditional approaches to oral health care have emphasized curative therapy over population-based preventive treatments.[1]

Herbal medicine has a lot of potential as an oral disease-curing ingredient that may be utilized to treat dental problems. Herbal therapy is becoming more popular as an alternate means of treating dental issues in developed countries around the world. Their products have been employed as adjuvants in the treatment of dental disease due to the lower side effects.[5]

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Different treatable dental diseases with herbal medicine such as dental caries, toothache, gingivitis, ulcerative gingivitis, mouth ulcers, swollen tonsil, oral thrush, tonsillitis, and black tongue are common in traditional health practice.[6] The different components of *Zingiberofficinalis* include 1-4 % essential oil, oleoresin, zingiberene, curcumin, sesquiterpenes, phellandrene, and bisabolene. It is used to relieve toothache, as a sialagogue in the treatment of oral thrush.[7]Syzygiumaromaticum consists of essential oil eugenol, which has been used to treat toothaches, periodontitis, as an anesthetic, and bleeding gums, among other ailments. *Salvia officinalis* possesses antibacterial, antifungal, and antiviral properties, which could explain why sage is so beneficial for gingivitis.[7]

Although medicinal plants are widely used and assumed to be safe, however, they can potentially be toxic. When poisoning from medicinal plants has been documented, it's usually due to misidentification of the plants in the condition in which they're marketed or improper preparation and administration by someone who isn't properly qualified. While clove oil is considered safe when used properly, it can become toxic if used excessively. Tissue irritation is the most prevalent side effect, characterized by discomfort, swelling, redness, and a burning (rather than warming) sensation.[8] Therefore, the aim of this review is to highlight the benefits of several medicinal plants used for herbal medicine in the prevention and treatment of oral infections.

Methodology

An internet search using search engines such as Google, Google Scholar, Research Gate, PubMed, and Science Direct was conducted to find published papers from 2011 to 2020. The keywords used for the search terms were oral infections, herbal medicine, gingivitis, oral herpes, oral thrush, and dental decay. For this review, related articles were chosen.

Results and Discussion

Medicinal plants such as *Aloe vera, Camellia sinensis, Punica granatum, Glycyrrhiza glabra,* and others have been recognized as medicinal herbs beneficial in the prevention and management of oral

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infections based on the results collected. Gingivitis, oral herpes, oral thrush, and dental decay were the five topics covered in the papers.

A) Herbal extracts used for the treatment and management of gingivitis

Chronic gingival inflammatory conditions crucial etiology is often investigated to be bacterial plaque and its byproducts. There is also a well-established link between poor oral hygiene, dental plaque, and the severity of periodontal disease.[9] Phytonutrients and phytotherapy ingredients are being researched in a variety of plants. Several plants and plant parts with anti-inflammatory, antioxidant, antibacterial, astringent, and other beneficial qualities have been identified in the literature. These characteristics can be used to treat gingival and periodontal disorders. Herbs or phytotherapy materials frequently have several bioactive components with multiple targets during intake and therapy, as opposed to plant-derived pharmaceuticals, which often consist of one single natural ingredient in combination with other minor compounds[10]. Various plants and their applications have been listed in Table1

Table 1: Herbal extracts with the potential application to treat gingivitis

Plant name	Part used	Study type	Results	Ref.
Anacardium occidentale (Anacardiaceae)	Stem bark	Randomized controlled clinical study	The reduction of *Anacardium occidentale* gingivitis similar to that of chlorhexidine and effective in plaque control when compared to chlorhexidine	11
Azadirachta indica (Meliaceae)	Bark	Triple blind clinical study	Plaque and gingivitis reduction were better than that of chlorhexidine.	12
Azadirachta indica (Meliaceae)	Bark	*In vivo*	• Bleeding on probing was reduced. • Gingiva become firm and pink in color also plaque accumulation reduced.	13
Camellia sinensis (Theaceae)	Leaf	Randomized, blinded, controlled clinical study	• Green tea extract effect on gingiva was comparative to that of chlorhexidine • Green tea extract showed high antiplaque effect.	14
Camellia sinensis (Theaceae)	Leaf	Single blinded, randomized, controlled clinical study	• No difference in the decrease of plaque and bleeding indices improvement. • Green tea could be beneficial as adjuvant treatment to sure gingival inflammation.	15
Camellia sinensis (Theaceae)	Leaf	Single blinded, randomized, controlled clinical study	Significant decrease in plaque index, and gingival inflammation but no difference in tooth stain when compared to chlorhexidine	16
Camellia sinensis (Theaceae)	Leaf	*In vitro*	The antibacterial activity of chlorhexidine mouth rinse is greater than that of green tea mouth rinse	17
Camellia sinensis (Theaceae)	Leaf	Double blinded, randomized, controlled clinical study	Green tea extract is as effective as chlorhexidine mouthwash in plaque control and gingival inflammation	18
Curcuma longa (Zingiberaceae)	Rhizome	Random clinical study	Curcumin mouthwash and chlorhexidine could have similar effect on gingivitis and plaque prevention.	19
Curcuma longa (Zingiberaceae)	Rhizome	Pilot randomized clinical study	Curcumin solution and chlorhexidine show similar efficacy on gingivitis.	20
Lippia sidoides (Verbenaceae)	Leaf	Parallel controlled clinical trial	Both chlorhexidine and *Lippiasidoides* containing product has effective control on gingivitis	21
Matricaria chamomilla (Asteraceae)	Flower	Double blind, randomized,	*Marticaria chamomilla* reduced gingival bleeding in patients with gingivitis as chlorhexidine mouth	22

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		controlled pilot study	wash did.	
Ocimum sanctum (Lamiaceae)	Leaf	Triple blinded, randomized, controlled clinical study	Both *Ocimum sanctum* and chlorhexidine show the same effectiveness in reducing gingivitis and reducing plaque index and bleeding.	23
Punica granatum (Lythraceae)	Seed	Randomized, Clinical study	The extract did not prevent the plaque formation but it can reduce the count of gram-negative bacilli and cocci.	24
Punica granatum (Lythraceae)	Fruit	Double blind, parallel clinical study	Gingival status improved, plaque reduced and bleeding indices reduced.	25
Punica granatum (Lythraceae)	Fruit	Randomized clinical study	Sufficient improvement in gingival status but not effective in plaque score reduction	26
Punica granatum (Lythraceae)	Fruit peel	Prospective double blind, randomized clinical study	*Punicagranatum* is not effective in treating gingival inflammation but may reduce plaque index.	27
Salvadora persica (Salvadoraceae)	Stick	Single blinded, randomized, clinical study	Plaque score and gingival health improved when miswak is used as adjunct to toothbrush.	28
Salvadora persica (Salvadoraceae)	Stick	Double blinded, randomized clinical study	Dental plaque was reduced significantly.	29
Terminaliac hebula (Combretaceae)	Fruit	Double blinded, controlled, randomized clinical study	The improvement of gingival inflammation and microbial plaque of *Terminalia chebula* was similar to that of chlorhexidine.	23
Vaccinium myrtillus (Ericaceae)	Fruit	Randomized, controlled clinical study	The reduction of gingivitis is similar to that of standard treatment.	30

B) Herbal extracts used in the treatment and management of oral herpes

HSV-1 and HSV-2 are highly contagious herpes simplex viruses that cause lifelong, latent infections with recurrent outbreaks of oral and/or vaginal sores. HSV-1 and HSV-2 infections have no cure, however antiviral medicines are frequently used to prevent and treat outbreaks. Antiviral resistance has begun to arise, necessitating the development of new and effective prophylactic medicines.[31]

Medicinal plants have the potential to have beneficial impacts on HSV prevention and therapy due to the numerous modes of action that they can elicit. Some, in particular, have shown substantial antiviral efficacy at various phases of viral development. Natural medicines also offer fewer side effects, lower medication resistance, and lower toxicity than pharmaceutical treatments 32. Various plants and their applications have been listed in Table 2.

C) Medicinal plants used in the treatment and management of oral thrush

Candida sp. are the most prevalent fungal infections found in the oral cavity, and their transformation from safe commensals to pathogenic microbes is frequently linked to lowered immunity. Candida can be limited and superficial in the oral cavity, but it can also be systemic or invasive, and in immunocompromised people, it can even be fatal.[49]

Several plants exhibit anti-Candida activity, and some of them have lower minimum inhibitory concentrations, making them viable anti-Candida options. However, due to a lack of knowledge on their efficacy, safety, and kinetics, none of these plant items are marketed for anti-Candida therapy.[50]Various plants and their applications have been listed in Table 3.

Table 2: Herbal extracts with the potential application to treat oral herpes

Plant name	**Plant used**	**Study type**	**Results**	Ref
Arisaema tortuosum (Araceae	Leaf	*In vitro*	Chloroform extract had a moderate antiviral activity against Herpes simplex virus (HSV-1).	33
Tanacetum parthenium (Asteraceae)	Arial art	*In vitro* *In vivo*	Hydroethanolic extract showed antiviral activity against HSV-1. In comparison with acyclovir, topical and oral	34

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			treatment mildly improved HSV-1 infection.	
Chrysactinia Mexicana (Asteraceae)	Root	*In vitro*	All extracts showed antiviral activities against HSV.	35
Ceanothus Coeruleus (Rhamnaceae)	Root			
Hamelia patens (Rubiaceae)	Leaf			
Salvia ballotiflora (Lamiaceae)	Arial art			
Clematis drummondii (Ranunculaceae)	Arial art			
Juglan smollis (Juglandaceae)	Corlex			
Spirogyra spp. (Zygnemataceae)	Whole plant	*In vitro*	The results showed that all extracts had anti HSV activity but the highest one was obtained from the ethanolic extract.	36
Quercus brantii (Fagaceae)	Fruit	*In vitro*	The results obtained showed that the extract had an inhibitory effect during and after adsorption stages of HSV-1 replication.	37
Hemidesmus indicus (Apocynaceae)	Root	*In vitro*	Extract showed a remarkable effect on pre-infection stage by reducing viral infectivity.	38
Graptopetalum paraguayense (Crassulaceae)	Leaf	*In vitro*	Extract exhibited a significant antiviral activity when applied on acyclovir-resistant strain of HSV.	39
Erythrina speciosa (Fabaceae)	Leaf	*In vitro*	Extract showed antiviral activity against HSV-1.	40
Veronica persica (Plantaginaceae)	Aerial part	*In vitro*	The results revealed the potential of methanolic extract to inhibit HSV infection.	41
Cornus canadensi (Cornaceae)	Stem and leaf	*In vitro*	All extracts showed antiviral activity against HSV-1.	42
Arctium lappa (Asteraceae)	Fruit	*In vitro*	It was demonstrated that the extract of this medicinal plant had an antiviral activity against HSV-1.	43
Euphorbia spinidens(Euphorbiaceae)	Aerial part	*In vitro*	The findings showed that the methanol extract had a significant antiviral activity against HSV-1.	44
Glycyrrhiza glabra (Fabaceae)	Root	*In vitro*	Water extract showed antiviral activity against HSV-1.	45
Sasa senanensis (Poaceae)	Leaf	*In vitro*	Using this medicinal plant in combination with popular antiviral agents resulted in synergistic effect against HSV.	46
Schinus terebinthifolia (Anacardiaceae)	Stem bark	*In vivo*	An observable protection against lesions was obtained from using the hydroethanolic extract.	47
		In vitro	All the tested strains of HSV were inhibited by using the crude hydroethanolic	

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			extract.	
Strychno spseudoquina (Loganiaceae)	Stem bark	*In vitro*	Many steps related to HSV replication cycle including adsorption, post-adsorption and penetration was affected by the extract.	48

D) Medicinal plants used in the treatment and management of dental decay

Tooth caries is a complex, dynamic disease caused by biofilms that causes phasic demineralization and remineralization of dental hard tissues. Caries can affect the tooth crown and, later in life, exposed root surfaces, and can occur in both primary and permanent dentitions.[57]

Medicinal plants have the potential to be developed into antimicrobial plaque agents, antiseptics, antioxidants, antimicrobials, antifungal, and analgesics, as well as preventive and therapeutic agents for dental decay.[58]Various plants and their applications have been listed in Table 4a and 4b.

Natural substances and herbal treatments have been used in the past and have been documented. Herbs are used to make a number of popular conventional medications. Aspirin (derived from white willow bark), digitalis (derived from foxglove), and sudafed are among them (modelled after a component in the plant ephedra). The potency of herbal products might vary.[66]

They are useful in the treatment of a variety of infections. Some of these have recently been evaluated for antibacterial potential against oral microorganisms.[67] Camellia sinensis has been used in a variety of ways, including mouthwash, sweets, and slow-release local delivery systems.[67] Aloe vera gel at optimum concentrations in different kinds of toothpaste or mouthwashes could be useful for the prevention of periodontal diseases and dental caries.[68] Some plants, such as miswak, have been made into chewing gum, which could be a good dose for children.[69] Other extracts, such as turmeric gels, can be applied to wounded areas due to the plant's safety and would be particularly appealing to children who may have difficulties complying with mouthwashes or dentifrices.[70] The anti-inflammatory properties of herbal medicine are one of the most important aspects of controlling oral diseases. Flavonoids and tannins, which are anti-inflammatory and astringent compounds found in medicinal plants like pomegranate, tea, and chamomile, aid to control bleeding and inflammation.69

Controlling the microbiota of the mouth cavity is another key consequence. Herbal extracts have been shown in several trials to reduce the bacterial count of oral infections and plaque development. Rinsing with herbal mouthwashes or using herbal dentifrices, as well as any other type of applications, can have a bactericidal effect and inhibit the multiplication of pathogens.[71,72] Furthermore, some studies investigated the effect of combining herbal treatments with traditional mechanical dental practices such as scaling, and discovered that they had a synergistic effect, implying that herbal products can be used as a complementary therapy to improve the effectiveness of traditional therapies.[73] Furthermore, several common herbal medications, such as gingko, garlic, ginseng, peppermint oil, senna, primrose oil, isapghol, and ephedra, have been linked to severe adverse drug reactions, ranging from minor gastrointestinal distress to life-threatening bleeding issues. Concerns about the safety of allopathic drugs are growing, and people are becoming more aware of the problem.[74]

Table 3: Herbal extracts with the potential application to treat oral trusth

Plant name	Plant used	Type of study	Results	Ref
Acacia nilotica (Fabaceae)	Leaf	*In vitro*	The extract has weak activity in inhibiting *candida albicans*(*C. albicans*).	51
Acacia nilotica (Fabaceae)	Stem	*In vitro*	Has high inhibition effect against *C. albicans.*	52
Azadirachta indica (Meliaceae)	Leaf	*In vitro*	The extract is very effective against *C. albicans.*	51
Azadirachta indica (Meliaceae)	Leaf	*In vitro*	Has high inhibition effect against *C. albicans* but weak inhibition effect against other orally grown microorganism.	52
Calendulla officinalis (Asteraceae)	Flower	*In vitro*	Not effective against *Enterococcus faecalis*(*E. faecalis)* and streptococcus species.	52
Centella asiatica (Apiaceae)	Leaf	*In vitro*	Has weak activity against *C. albicans* and other microorganisms grow in mouth cavity.	52
Citrus sinesis (Rutaceae)	Fruit part	*In vitro*	Has higher activity than chlorhexidine against *Lactobacillus acidophilus* (*L. acidophilus*) but not *C. albicans*	52
Datura stramonium (Solanaceae)	Leaf	*In vitro*	The extract is very effective against *C. albicans*	51
Dragon Blood tree (Asparagaceae)	Resin	*In vitro*	The extract is very effective against *C. albicans.*	51
Elettaria cardamomum (Zingiberaceae)	Seed	*In vitro*	The extract is very effective against *C. albicans.*	51
Emblica officinalis	Fruit	*In vitro*	Has higher activity than chlorhexidine against *L.*	52

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(Euphorbiaceae)			*acidophilus* but not *C. albicans*	
Eucalyptus globules (Myrtaceae)	Leaf	*In vitro*	Has significant inhibition effect on the growth of *C. albicans.*	53
Jatropha curcas (Euphorbiaceae)	Stem	*In vitro*	Has significant inhibitory effect on both *C. albicans* and *Candida tropicalis (C. tropicalis*).	53
Lannea coromandelica (Anacardiaceae)	Twig	*In vitro*	Has weak activity against *C. albicans* and other microorganisms grow in mouth cavity.	52
Mangifera indica (Anacardiaceae)	Stem	*In vitro*	Not effective against *E. faecalis* and streptococcus species.	52
Mentha piperita (Lamiaceae)	Leaf	*In vitro*	Has high inhibition effect against *C. albicans* and has higher activity than chlorhexidine against *L. acidophilus.*	52
Ocimum sanctum (Lamiaceae)	Leaf	*In vitro*	Has strong anti-microbial effect against all oral pathogens.	52
Ocimum santacum (Lamiaceae) with Piper (Piperaceae)	Leaf betle	*In vitro*	• Both extracts inhibited the growth of *Candida albicans* but the MIC of betle was lower than that of *O. santacum.* • Both extracts minimum inhibitory concentration) MIC are higher than that of fluconazole.	54
Piper nigrum (Piperaceae)	Seed	*In vitro*	The extract is very effective against *C. albicans.*	51
Prunella vulgaris (Lamiaceae)	Leaf	*In vivo*	The extract acts effectively against *C. albicans* organisms thus could be effective against oral thrush with antioxidant activity.	55
Psidium guajava(Myrtaceae)	Twig	*In vitro*	Has strong antimicrobial activity against all oral pathogens.	52
Rosa centifolia (*Rosaceae)*	Flower	*In vitro*	Has weak activity against *C. albicans* and other microorganisms grow in mouth cavity.	52
Solanum lycopersicum (Solanaceae)	Fruit	*In vitro*	The methanolic extract has inhibitory effect on *C. albicans* and could be promising treatment against oral thrush.	56
Zanthoxylum zanthoxyloides (Rutaceae)	Root	*In vitro*	Has significant inhibition effect on *C. tropicalis* but not on *C. albicans.*	53
Vernonia amygdalina (Asteraceae)	Stem	*In vitro*	Has significant inhibition effect on the growth of *C. albicans.*	53
Withania somnifera (Solanaceae)	Root	*In vitro*	Has high inhibition effect against *C. albicans.*	52
Zingiber officinale (Zingiberaceae)	Rhizome	*In vitro*	The extract has weak activity in inhibiting *C. albicans.*	51
Ziziphus jujube (Rhamnaceae)	Leaf	*In vitro*	The extract is very effective against *C. albicans.*	51

Table 4: Herbal extracts with the potential application against bacteria of dental decay

Plant name	**Part used**	**Study type**	**Results**	**Ref.**
Ocimum sanctum (Lamiaceae)	Leaves	*In vitro*	Ethanolic extract showed antimicrobial activity against *Streptococcus mutans.*	59

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Rosa damascene (Rosaceae) *Rosmarinus officinalis* (Lamiaceae)	Flower Leaves	*In vitro*	The results demonstrated a potent inhibitory effect against oral streptococci.	60
Hibiscus rosa-sinensis (Malvaceae)	Leaf	*In vitro*	Both aqueous and ethanolic extracts revealed antimicrobial activities against two cariogenic bacteria. *Lactobacillus acidophilus* and *Streptococcus mutans*.	61
Cinnamomum zeylanicum (Lauraceae)	Bark	*In vitro*	It was demonstrated that essential oils extracted from both herbs had antimicrobial and anti-plaque effects.	62
Zanthoxylum chalybeum (Rutaceae) *Euclea Latidens* (Ebenaceae)	Pulp	*In vitro*	Plants extracts showed antibacterial activities against *Streptococcus mutans* and *Lactobacillus acidophilus* which associated with dental caries.	63
Allium sativum (Amaryllidaceae)	Fruit	*In vitro*	It was found that ethanolic extract of garlic had antibacterial activity against *Streptococcus mutans* and *Lactobacillus acidophilus*.	64
Terminalia chebula (Combretaceae) *Achyranthes aspera* (Amaranthaceae) *Psidium guajava* (Myrtaceae) *Mimusops elengi* (Spotaceae)	Fruit Root Leaf Stick	*In vitro*	All four ethyl acetate extracts exhibited antibacterial activity against *Streptococcus mutans.*	65

Conclusion

There is abundant evidence that plant extracts have the potential to be transformed into compounds that can be used as preventative treatments for oral infections, as demonstrated by the examples presented in this article. While the number of clinical trials for such products is encouraging, more research into their safety and efficacy will be required to determine whether they offer therapeutic benefits, either alone or in combination with conventional therapies, that can help to reduce the global burden of oral diseases. Studies that address difficulties such as statistical power, blinding, standardization of extracts or purified chemicals, and quality control, in particular, would be extremely beneficial. The key aim for studying medicinal plants is linked with searching safer and effective alternatives to present drugs used for oral infections treatment which are costly and very often require extended treatment.

Conflict of interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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