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A Review of the Most Widely Used Medicinal Plants in the Treatment of Dental and Oral Disorders and Diseases

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ABSTRACT

Today, the use of medicinal plants and their ingredients in the preparation of many drugs for the prevention and treatment of dental and oral disorders and diseases has been considered. This study aimed to investigate the effect of medicinal plants on caries and tooth infections. For this review study, keywords such as gingivitis, antiparasitic, antibacterial, antiviral, antioxidant, analgesic, anti-inflammatory, and dental plaque were used. The search engines and databases searched for in those articles were Google Scholar, Scopus, PubMed, and Web of Science. Many herbs or their derivatives are used in commercial toothpaste to relieve oral side effects. The essential oils and various extracts of these herbs have shown antifungal, antiparasitic, antibacterial, antiviral, antioxidant, analgesic, and anti-inflammatory properties. Identifying and using these plants and their derivatives can help pharmacologists and researchers to discover new effective drugs for treating dental diseases.

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Introduction

Oral infections are the most common human infections worldwide. The most common infections include halitosis, tooth decay, and oral gum diseases such as gingivitis and periodontitis. Bacteria are the main cause of these harmful infections. Today, bacterial biofilms are the main reason of pathogenesis involved in the occurrence of oral infections. The various bacteria in these biofilms form a complex and extensive interaction to survive (Huang et al., 2011). A biofilm is a complex composed of microorganisms that are attached to a surface.

Streptococcus is a potent gram-positive bacterium that lives in the mouth and creates an acidic environment by metabolizing various carbohydrates. Extracellular glucan synthesis is the main mechanism involved in pathogenesis

of these bacteria. It is the cause and cause of dental caries in animals and humans (Biswas and Biswas, 2005). Extracellular glucan, especially insoluble glucan synthesized from sucrose via glucosyltransferase, allows bacteria to accumulate on the tooth surface by binding. Along with other microorganisms in the development of extracellular polysaccharide matrix, the mass formed in the form of dental biofilm is formed under the name of dental plaque and creates a bad odor in the mouth (Ruhul and Kataria, 2021).

Oral hygiene in different people, sex, age, body hormones, and immune system status, especially genetics and diet are among the most important factors affecting this diversity of microbial ecosystems that dominate the oral cavity (Singer et al., 2010).

The most important bacteria available are *Actinobacillus actinomycetemcomitans*, *Eikenella corrodens*, *Porphyromonas gingivalis*, *Protella intermedia*, and *Fusobacterium nucleatum*. Among these bacteria, *Porphyromonas gingivalis* is more important (Kumar et al., 2003).

Periodontal treatment aims to cure inflamed tissue, reduce the number of pathogenic bacteria and eliminate the diseased pockets. Mechanical therapy, chemotherapy, and systemic administration of antibiotics are some of the clinical methods being utilized currently. Traditional periodontal treatment includes scaling (removing tartar and plaque), curettage to remove inflamed soft tissue, and root planning (removing necrotic tissue from the root surface). Periodontal diseases are associated with bacterial infections; therefore, antibacterial treatment seems to be an appropriate method of improving the condition of the inflamed tissues. One of the major problems associated with conventional treatment of systemic administration of antibiotics is the distribution of drugs throughout the body, which is not required and can also give rise to toxicity problems (Kumar et al., 2009).

Various chemical methods are used to control plaque and tooth infection. Chlorhexidine belongs to the group of antiseptics and prevents the formation of plaque and nausea. The most important side effect of chlorhexidine is a change in tooth color (Soheilifar et al., 2021).

Today, due to the apparent effects of the abuse of chemical drugs for most consumers, the desire of people to use medicinal plants has increased significantly. According to the World Health Organization, today 80% of the world's population turn to medicinal plants for the

treatment of their clinical problems (Ekor, 2014). For example, the evidence for the effectiveness of green tea in reducing tooth decay in humans and laboratory animals has been suggested, suggesting that green tea can dramatically reduce the level of *Streptococcus mutans* in saliva and reduce the risk of caries. On the other hand, there is evidence of indirect antibacterial effect by increasing the secretion of salivary protective compounds such as immunoglobulins, lysozyme, electrophilic, histatins, and mucin (Valadas et al., 2021).

This study was conducted to review the most widely used medicinal plants for periodontal diseases and tooth infections

Materials and Methods

For this review study, keywords such as gingivitis, antiparasitic, antibacterial, antiviral, antioxidant, analgesic, anti-inflammatory, and plaque were used. The engines and databases searched for in those articles were Google Scholar, Scopus, PubMed, and Web of Science.

Results

The most widely herbal products used for oral disorders and diseases have been shown in table 1. The essential oils and various extracts of these herbs have antifungal, antiparasitic, antibacterial, antiviral, antioxidant, analgesic, and anti-inflammatory properties.

Table 1: The most widely used herbal oral products

Plant species	Family name	Part of the plant collected	Therapeutic effect	References
<i>Cocos nucifera</i>	Arecaceae	Coconut water	Antiviral, antifungal, and antibacterial	(Adwan et al., 2012)
<i>Camellia sinensis</i>	Theaceae	Leaf, essential oil, and the aquatic extracts	Antifungal, anti-gingivitis, and plaque	(Jenabian et al., 2012)
<i>Rosmarinus officinalis</i>	Lamiaceae	Leaf and essential oil	Anti-gingivitis	(Mahyari et al., 2016)
<i>Aloe vera</i>	Liliaceae	Leaf	Anti-gingivitis and plaque, antiulcer, and antibacterial	(Chandrasah et al., 2012)
<i>Curcuma longa</i>	Liliopsida	Rhizome	Anti-gingivitis, anti-inflammatory, antioxidant, antimicrobial, and antiseptic	(Mali et al., 2012)
<i>Salvadora persica</i>	Salvadoraceae	Leaf, wood, fruit, and seed	Antibacterial, antiviral, and anti-gingivitis	(Halawany, 2012)
<i>Terminalia chebula</i>	Combretaceae	Fruit	Antibacterial and anti-gingivitis	(Velmurugan et al., 2013)
<i>Phyllanthus emblica</i> L.	Phyllanthaceae	Fruit	Antibacterial, anti-gingivitis, and plaque	(Naiktari et al., 2014, Aspalli et al., 2014)
<i>Azadirachta indica</i>	Meliaceae	Leaf, wood, and essential oil	Antibacterial, anti-gingivitis and anti-plaque	(Adwan et al., 2012)
<i>Mangifera indica</i>	Anacardiaceae	Fruit	Antioxidant, immunoprotective, anti-cancer, anti-inflammatory, antimicrobial properties, prevention and treatment of periodontitis, inhibition of oral streptococcus, and reduction of plaque and oral inflammation	(Adwan et al., 2012)
<i>Ocimum basilicum</i>	Lamiaceae	Leaf and seed	Antimicrobial, antifungal	(Sharma et al., 2014, Naiktari et al., 2014)
<i>Matricaria chamomilla</i>	Asteraceae	Leaf and essential oil	Antibacterial, antiviral, antifungal, and anti-inflammatory	(Adwan et al., 2012, Panahi et al., 2010)
<i>Acacia senegal</i>	Primulaceae	Skin and essential oil	Antibacterial, anti-protease, anti-inflammatory, and anti-plaque	(Makkar et al., 2013)
Pomegranate extract	Punicaceae	Fruit	Antifungal, anti-cancer, anti-gingivitis, and antibacterial	(Hajifattahi et al., 2016)
<i>Glycyrrhiza glabra</i>	Fabaceae	Root extract	Antibacterial and antifungal	(Jafari-Sales and Bolouri, 2018)
<i>Berberis vulgaris</i>	Berberidaceae	Fruit and leaf	Antibacterial	(Somu et al., 2012)

The results showed that green tea polyphenols have an inhibitory effect on the growth of *Escherichia coli* and *Staphylococcus aureus*. Because these bacteria are involved in causing plaque and decay. It also reduces bleeding and the amount of dental plaque.

Polysaccharides in *Aloe Vera*, *Curcuma longa*, *Echinacea angustifolia*, *Mangifera indica*, and *Azadirachta indica* have anti-inflammatory properties and modulation safety effects. *Syzygium aromaticum* oil is commonly used to relieve toothache. *Glycyrrhiza glabra* root is used to prevent rot. *Cocos nucifera* has antiviral, antifungal, and antibacterial properties and can be used to wash the root canal.

The resin of *Cyamopsis tetragonoloba* and *Commiphora molmol* L. has anti-inflammatory, analgesic, and inhibitory growth of microorganisms and heal inflammation and wounds of the mouth.

Extract of *Phyllanthus embica* L. gradually reduces the pH of the mouth and acts as a saliva-boosting agent. The antibacterial effect of *Phyllanthus embica* L. is greater than that of *Terminalia chebula*.

Discussion

The use of chemical drugs to treat diseases has led to the emergence of resistant microbial isolates, the number of which is increasing every day. Plants and their compounds, including various essential oils and extracts, have the potential to be replaced by chemical drugs (Tariq et al., 2019). According to the World Health Organization, 80% of the world's population uses traditional herbs for the initial treatment of their diseases (Ekor, 2014).

Most of the extracted plant essential oils that have been found for the prevention and treatment of oral diseases have anti-fungal, anti-parasitic, anti-inflammatory, anti-bacterial, anti-viral, antioxidant, and cytotoxic properties. People get toothache at least once in a lifetime experience. Toothache is pain that usually begins in all the bones of the jaw and the skull might be involved. One of the most important factors for toothache is tooth decay. Some herbs such as garlic, ginger, coconut, pepper, cloves, onion, turmeric, sesame, and so on are used in traditional medicine to treat toothache (Dagli et al., 2015). In another study, the results showed that *Salvadora persica* stick had significant effects in preventing tooth decay and oral diseases (Haque and Alsareii, 2015).

One of the plants that have been studied by researchers is green tea. Various mechanisms have identified the anti-caries properties of green tea. Studies show that the duration of tooth exposure by this substance has a positive effect on its anti-caries. Therefore, using green tea extract can increase the duration of tooth exposure to this substance. In the study of Narotzki et al. (Narotzki et al., 2012) and Araghizadeh et al. (Araghizadeh et al., 2013) the inhibitory effect of green tea extract on bacteria that cause decay was confirmed. Laboratory studies show that the catechins in green tea prevent the binding of *Streptococcus* pathogens to the tooth surface. Another mechanism is the anti-caries property of green tea by inhibiting glucosyltransferase and amylase (Ferrazzano et al., 2011).

Pomegranate is very useful for oral health. And the antioxidants in it eliminate the cause of tooth decay.

Toothpaste containing it stimulates the activity of plaque-causing microorganisms and prevents the formation of plaque. Pomegranate has anti-inflammatory compounds. Research shows that pomegranate prevents microorganisms and substances from bacteria from settling on the surface of the tooth. Pomegranate extract reduces the protein responsible for damage and the enzyme responsible for breaking down sucrose. Studies show that pomegranate extracts have been shown to reduce pain and infection caused by oral plaque and candidiasis. The effect of hydroalcoholic extract of pomegranate on microbial plaques of teeth has also been studied, which has the same effect as chlorhexidine mouthwash (Gavanji et al., 2014, Mehta et al., 2014).

Among traditional medicinal plants, *Glycyrrhiza glabra* root and stem and *Aloevera* leaf are often introduced as plants with antimicrobial properties and studied and used therapeutically. In a study, *vera* extract was effective on *Escherichia coli*, *Staphylococcus epidermis*, *Salmonella typhimurium*, *Bacillus subtilis*, *Enterococcus faecalis*, *Proteus vulgaris*, and *Pseudomonas aeruginosa* (Royani et al., 2022). The results studies also showed that ethanolic, methanolic, hexane, and ethyl acetate extracts of *Terminalia chebula* (11), *Morinda Citrifolia* (1), *Berberis vulgaris* (20), have antibacterial effects on *Streptococcus mutants*, and *Candida albicans*.

Due to the high amount of vitamin C, *Phyllanthus embica* L. (Gao et al., 2018) prevents bleeding gums. The combination of this plant with *Chebula terminalia* (11) is an effective mouthwash to reduce plaque and gingivitis and is as effective as chlorhexidine. Phenolic compounds of *Phyllanthus embica* L. are involved in preventing tooth decay and inhibiting viruses and *Streptococcus mutants* (Gao et al., 2018).

In general, medicinal plants have many therapeutic properties, including antimicrobial properties, due to their different phytochemical compositions. Much research has been done on the biological properties of many essential oils. Essential oils act primarily against the cytoplasmic membrane of microorganisms. Hydrophobicity is an important feature of essential oils and their components that enable them to accumulate in cell membranes and disrupt structures and increase permeability (Tariq et al., 2019).

Conclusions

Oral medicines are health products that have been widely used by people for many years. Studies show that plant-based compounds can affect oral health in a variety of ways. There are several pieces of evidence about the various biological properties of medicinal herbs and their active ingredients such as antioxidant, antimicrobial and anti-inflammatory effects. Therefore, according to the role of bacteria in the occurrence of oral and dental problems, the use of medicinal plants can be a useful solution due to their therapeutic properties. It seems that the phytochemical constituents found in these plants play an important role in the effects against oral and dental diseases. However, more studies in this field are necessary.

Conflict of interest

There is no conflict of interest among the authors

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