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## Review Article

# Herbs Used in the Treatment of Periodontal Disease: A Review

**Sonali Shende\*, Shridhar Deshpande, Dr. Vishnu Kangralkar, Snehal Ogale,  
Spoorti Malki**

*Department of Pharmacology, Maratha Mandal's College of Pharmacy, Belgaum, 590016. Karnataka, India.*

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## ABSTRACT

Periodontal disease is a chronic inflammatory disease of the supporting structures of the teeth, which is mainly caused by dental plaque-associated biofilms and mainly by over- or excessive host immune inflammatory responses. Gingivitis can progress to periodontitis, which causes alveolar bone loss and destruction of the surrounding connective tissue, which can cause tooth loss. Conventional periodontal therapy (scaling, root planning, and antimicrobial agents) is effective but has some limitations, such as partial removal of biofilm, side effects and resistance to the antimicrobial agents. These challenges have increased interest in alternative and adjunctive therapeutic approaches. The safety, low cost and the vast array of biological activities have made phytotherapy a topic of interest. This review summarizes the pathogenesis of periodontal disease and the anti-pathogenic and anti-host-mediated tissue damage effect of the commonly used medical herbs—neem, turmeric, clove, ginger, liquorice, pomegranate, Tulsi, sage, rosemary, and barberry—containing bioactive compounds with antibacterial, anti-inflammatory, antioxidant, and immunomodulatory activities. There is evidence that herbal products can be used as useful complementary treatments for the prevention and treatment of periodontal disease.

## INTRODUCTION

Periodontal diseases" is a generic term for a variety of chronic inflammatory conditions of the soft tissue that surrounds the teeth, the gingiva (gums).

The bone and ligament, which are collagen fibers in connective tissue, support the teeth and link a tooth to alveolar bone. Periodontal disease is the initial stage of an infection of the gums (gingiva) that results from

bacteria in dental plaque, a microbial film that forms on teeth and gums. The gingivitis caused by plaque is known as gingivitis. If left untreated, gingivitis may progress to chronic periodontitis; the gingiva, bone, and ligament may become lost, leading to the characteristic "pockets" that are a hallmark of the disease and possibly even tooth loss.<sup>1</sup> The presence of biofilm linked to dental plaque is the main cause of

**\*Corresponding Author:** Sonali Shende

**Address:** Department of Pharmacology, Maratha Mandal's College of Pharmacy, Belgaum, 590016. Karnataka, India.

**Email** ✉: [shendesonali151@gmail.com](mailto:shendesonali151@gmail.com)

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periodontitis. Microbial biofilms that stick to the surface of teeth make up dental plaque. The immune and inflammatory reactions of an individual to tooth plaque bacteria are what lead to the development of periodontitis; these reactions may be affected by environmental factors.<sup>2</sup>

Gingivitis refers to a reaction of the marginal gingiva to dental plaque and is the most prevalent reversible periodontal disease, the first stage where periodontal disease is manifested.<sup>3</sup> Although traditional periodontal therapy (scaling, root planing, and adjunctive antimicrobials) is helpful, it can be complicated by incomplete biofilm removal, side effects of the medication, and antimicrobial resistance.<sup>4</sup> Therefore, alternative methods such as phytomedicine and professional and patient-administered mechanical therapy are gaining popularity with patients today in developing countries.<sup>5</sup>

Herbal phytomedicines are well tolerated, accepted by patients and have a long shelf life. They are a renewable resource and can supply a steady stream of inexpensive drugs to keep up with the world's expanding population. Medicinal herbs are easily obtainable in both the developing and developed countries. For rural communities in some regions, these medications may be their sole choices. Other sources have reported that the medicinal herbs are used by millions of people globally.<sup>6</sup> Medicinal herbs are rich in bioactive compounds like flavonoids, tannins, alkaloids, terpenoids, and phenolic acids with antibacterial, anti-inflammatory, antioxidant, and immunomodulatory properties, which contribute to the periodontal repair.<sup>7</sup>

A number of commonly used herbs, including *Azadirachta indica* (neem), *Curcuma longa* (turmeric), *Salvadora persica* (miswak), *Aloe vera*, *Ocimum sanctum* (tulsi), *Camellia sinensis* (green tea) and *Punica granatum* (pomegranate), have been reported to inhibit major periodontal pathogens like *Porphyromonas gingivalis*, *Prevotella intermedia*, and *Aggregatibacter actinomycetemcomitans*.<sup>8,9</sup>

Herbs have been shown to have multiple mechanisms of action in alleviating periodontal inflammation, bleeding on periodontal probing, and oxidative stress and promoting wound healing.<sup>10</sup> When used as mouthwashes, gels, dentifrices, or local delivery of herbal

medicines, which may make them safe and effective periodontal disease prevention and treatment adjuncts; further, there is an increasing interest in evidence-based phytotherapy.<sup>11,12</sup>

## HERBS USED: -

### 1. Licorice (*Glycyrrhiza glabra*):

Liquorice is a medicinal herb that is well-known for its antibacterial, anti-inflammatory, antioxidant and immunomodulatory properties, and these components are believed to be responsible for the use of liquorice in traditional medicine in relation to periodontal disease. In addition to its antimicrobial properties, licorice has also demonstrated strong anti-inflammatory effects, including inhibition of the cyclooxygenase and lipoxygenase pathways, resulting in a decrease in the production of prostaglandin and leukotriene.<sup>13,14</sup> Licorice also downregulates the expression of pro-inflammatory cytokines, such as IL-1 $\beta$ , TNF- $\alpha$ , and IL-6, thereby limiting gingival inflammation and connective tissue breakdown.<sup>15</sup> Licorice also has a beneficial role in periodontal healing through reducing oxidative stress and regulating host immune responses. The combination of these properties has also led to the use of licorice as an add-on to regular periodontal treatment in herbal mouthwashes, gels, and lozenges.<sup>16</sup>

### 2. Ginger (*Zingiber officinale*)

The anti-inflammatory and antioxidant effects of ginger are largely due to its active ingredients gingerols, shogaols, and zingerone, which inhibit the activity of cyclooxygenase and lipoxygenase pathways, thereby decreasing the synthesis of inflammatory mediators such as prostaglandins and leukotrienes, which are responsible for periodontal inflammation.<sup>17</sup>

In addition, the antibacterial properties of ginger have been observed against the major periodontopathogens, including *Prevotella intermedia* and *Porphyromonas gingivalis*, and help to reduce the levels of these bacteria and the formation of biofilm.<sup>18</sup> Ginger's antioxidant properties also help neutralize excess reactive oxygen species, which protects periodontal tissues against damage and promotes repair.<sup>19</sup> Ginger contains sesquiphellandrene, 1-4% essential oils, alcohols, bisabolene, zingiberene, curcumin, oleoresins,

monoterpene aldehydes, and other compounds. It is rich in antimicrobial, analgesic, and anti-inflammatory properties. It is also used to relieve toothache as a sialagogue, which is commonly used in the treatment of oral thrush. It may help lessen the fatal effects of the chemotherapy drug cyclophosphamide. Should not be used in pregnancy or by those with biliary disease. People who are on blood thinners (such as heparin or coumadin) should be careful about taking ginger, as it may affect their ability to clot blood. Ginger consumption along with nonsurgical periodontal therapy can reduce oxidative anxiety, enhance the periodontal anti-inflammatory action, and increase the serum levels of antioxidant enzymes.<sup>20</sup>

### 3. Barberry (*Berberis vulgaris* L.);

It's talking about the group of plants in the plant family Berberidaceae. Berberine is an alkaloid compound that can be extracted from *Berberis vulgaris* L. Because of its antibacterial qualities, it is often used in mouthwash and toothpaste.<sup>21</sup> Another benefit of the gel is its ability to strengthen the body's resistance due to its high concentration of vitamin C and to improve iron absorption.<sup>22</sup> Palombo said that alkaloids like berberine were very effective in combating bacteria like *Aggregatibacter actinomycetemcomitans* and *Porphyromonas gingivalis*. Makarem and Asodeh have found that berberine gel inhibits the activity of collagenase in *Aggregatibacter actinomycetemcomitans* and *Porphyromonas gingivalis* and decreases oral biofilm by approximately 57% and the gingival index by approximately 34%.<sup>23</sup> Several investigations have shown that it has common pharmacological therapeutic properties such as anti-inflammatory, anti-inducible nitric oxide synthase actions, and anticyclooxygenase activity. Strongly recommended for reducing destruction of periodontal tissue throughout the matrix for modulation of metalloproteinases in the evolution of periodontal disease.<sup>24</sup>

### 4. Sage (*Salvia officinalis* L.):

Sage is a herb from the Lamiaceae family. Sage grows in fields, gardens, and along roadsides. Herbal species include *Salvia officinalis* L., *Salvia lavandulaefolia* (Spanish sage), and *Mentha × piperita* L. Common names for the ingredients include menthol,

*Commiphora myrrha* Engl., *Matricaria chamomilla* L., and *Eugenia caryophyllus* (Spreng.). Bullock & S.G. Harrison (synonym of *Syzygium aromaticum* (L.)). Merr. & L.M. Perry (Myrtaceae), *Carum carvi* L. *Echinacea purpurea*.<sup>25</sup> Sage is antibacterial, fragrant, astringent, and antispasmodic. Sage, as a mouth wash, is used to treat a number of throat infections, tonsils, mouth ulcers, and gum ailments like gingivitis. Sage essential oils are used against stomatitis, sore throat, gingivitis, and periodontal infections and are antifungal, antibacterial, and antiviral. For remedy: Boil 150 mL of heated water with 3 g of chopped sage leaves for 10 minutes.<sup>26, 27</sup> Then filter to get clear liquid. The filtrate can be used as a mouthwash many times per day. Another prescription for mouth rinse is to take two tablespoons of chopped sage and pour half a liter of water over it and start boiling, then allow it to sit under a cloth for 15 minutes. Then filter the solution to obtain the filtered solution. For gargling or mouth rinsing several times daily for 5-10 minutes, the filtrate can be used. Narayanan and Thangavelu found that there was a marked decline in gingival indices with regular mouth rinses, and they speculated that mouth rinses could be used as a supplemental treatment to reduce inflammation. Sage tea should be avoided by pregnant and lactating women, but gargling and mouth rinsing may be recommended.<sup>28</sup>

### 5. Rosemary (*Rosmarinus officinalis* L.) :-

Rosemary is part of the Lamiaceae family of plants. It comprises of volatile oils with antifungal and antibacterial properties. It has also been determined to be effective in treating chronic candidiasis. The volatile oil of rosemary should be taken orally, diluted. The antioxidant and antibacterial properties of rosemary's essential oil properties have been reported in previous studies.<sup>29</sup> It has been reported that five essential oil constituents, verbenone,  $\alpha$ -pinene, borneol, 1,8-cineole, and camphor, have antibacterial properties. Valones et al. found that rosemary toothpaste has good reaction in comparison with verbenone and camphor, showing that the toothpaste reduced the biofilm and gingival bleeding.<sup>30</sup>

### 6. Pomegranate (*Punica granatum*):



Pomegranate extract was more effective than a pharmaceutical antifungal at reducing biofilm adherence when 3-4 bacteria were involved. Pomegranate contains active compounds with many beneficial effects against gingivitis, including the ability to decrease oxidative stress in the oral cavity, acting directly to neutralize free radicals; anti-inflammatory action; the ability to inhibit oral bacteria; and direct action on plaque that eliminates it from teeth. The study on the effect of pomegranate on gingivitis demonstrated that there was a significant decrease in gingival bleeding when a dentifrice containing pomegranate extract was used. Rinsing with pomegranate extract also decreased the activity of alpha-glucosidase (sucrase), an enzyme that cleaves sucrose (sugar), and increased the activity of ceruloplasmin (an antioxidant enzyme). Some researchers suggest that the pomegranate extract-induced rise in ceruloplasmin activity would result in an enhancement of antioxidant defense mechanisms.<sup>31</sup>

#### 7. Neem (*Azadirachta indica*):

Modern clinical research supports the old Ayurvedic practice of using neem plant parts to heal and renew gum tissue, as well as to prevent dental cavities and gum disease. The anti-plaque activity of the neem chewing sticks reported is also attributed to their fibrous nature, which leads to mechanical removal of plaque, but the neem plant is also reported to contain chemotherapeutic antiplaque agents. Gallo tannins in the initial stages of plaque formation could effectively reduce the amount of harmful microorganisms that adhere to the tooth surface by increasing the physical removal of plaque from the mouth (aggregation formation). In addition, the effectiveness of glucosyl transferase activity inhibition and adhesion reduction of bacteria in gallotannin extract solutions suggests anti-plaque activity. The germs in the inflamed gums are non-susceptible to antibiotics like penicillin and tetracycline but can be killed by plant extracts like neem. However, unlike antibiotics, antibacterial plant extracts did not cause allergies in the gingiva, a factor that may reduce its efficacy.<sup>32, 33</sup>

#### 8. Essential oil of clove (CEO; *Syzygium aromaticum* L. Myrtaceae :-)

A naturally dried flower bud of *S. Aromaticum* (clove) has antibacterial and antioxidant properties and is used in the treatment of toothaches. CEO is commonly employed to heal wounds and burns, to ease pain from dental procedures and for toothache, to treat tooth infections, and as an antiseptic. Clove oil has been shown to have an anticoagulant effect, blocking the production of thromboxane and aggregation of platelets. Moreover, platelet aggregation was not observed in the presence of clove oil with regard to the three substances that promote aggregation: platelet activating factor, arachidonic acid, and collagen. The results showed that clove oil is more effective than collagen in blocking PAF and aggregating platelets induced by arachidonic acid. Other constituents of clove, such as eugenol, have been shown to inhibit the biosynthesis of prostaglandins, the production of thromboxane B<sub>2</sub> and platelet aggregation.<sup>34</sup> Clove oil is effective against other periodontal pathogens, including *Candida albicans*, *Pseudomonas aeruginosa*, *S. aureus*, and *E. coli*. The clove has been shown to kill 70% of mouth bacteria, which is why clove oil is used in toothpaste. The anti-inflammatory activity of eugenol is thought to be due to its ability to downregulate prostaglandin biosynthesis, chemotaxis of neutrophils or macrophages, and expression of cyclooxygenase II. In addition, eugenol dimers have been demonstrated to exhibit chemopreventive properties by inhibiting the production of cytokines by the macrophages.<sup>35, 36</sup>

#### 9. Tulsi (*O. Sanctum*):

Tulsi (*O. sanctum*) is a member of the Labiatae family and can be recognized by its square stem and the aroma it gives off. The volatile oil found in tulsi leaves, which accounts for around 0.7% of its makeup, is mostly made up of eugenol (about 71%) and methyl eugenol (20%). Tulsi also possesses anti-germ properties against germs such as *S. aureus*, *S. mutans*, and *E. coli*. Furthermore, fixed oil in tulsi is anti-inflammatory against prostaglandin E<sub>2</sub> (PGE<sub>2</sub>)-induced edemas, leukotrienes, and arachidonic acid.<sup>37</sup> Furthermore, it possesses antiviral, antifungal, anticariogenic, and antiulcerogenic properties. Tulsi's incredibly complex chemical composition contains a variety of naturally occurring nutrients and biologically beneficial chemicals. The antibacterial properties of *O. sanctum* leaves



are mainly from their essential oils. These biologically active chemicals have the ability to break microbial strains' cytoplasmic membranes by stimulating the release of cellular potassium. These processes are effective against germs that cause systemic disease.<sup>38</sup> *In vitro* experiments revealed that Tulsi leaf extract was an antibacterial agent against *A. actinomycetemcomitans*. Moreover, tulsi has been suggested to exert immunomodulatory effects which help the host in resisting against infection by boosting interferon, interleukin-4, and T helper cells. Effect of Tulsi leaf on antimicrobial activity Mallikarjun S, Rao A, Rajesh G, Shenoy R, Pai M.<sup>39</sup>

### 10. Turmeric (*C. longa*): -

Tumeric contains a number of bioactive polyphenols, including the anti-inflammatory, anti-bacterial, antioxidant, hepatoprotective, antiseptic, and analgesic curcumin (diferuloylmethane) and a number of essential oils, including tumerone, atlanton, and zingiberone.

<sup>40</sup> All three types of sugars, proteins, and resins are

present. The antimicrobial effect was observed against the common periodontal pathogens when *C. longa* L. extract was used at 1%.<sup>41</sup> The use of 2% whole turmeric gel as a local medication administration technique seems to have the potential to increase the SRP. There was a substantial decrease in the activity of the trypsin-like enzyme in the "red complex" species. An application of a paste on teeth and gums twice a day treats periodontal disease. In another double-blind clinical study, curcumin was compared to a nonsteroidal anti-inflammatory drug (phenylbutazone) and placebo for anti-inflammatory effects following surgery, with curcumin proving to be more effective. Its powerful antioxidant properties also help to protect against the damage produced by free radicals. A 0.1% turmeric mouthwash was shown to be a beneficial addition to mechanical plaque removal as a treatment for gingivitis.<sup>42, 43</sup>

### Comprehensive Table of Herbs Used in Periodontal Therapy:

**Table: 1 Herbs Used in Periodontal Therapy**

| Sr. no. | Plant (Scientific name)                      | Family                                | Therapeutically Active Compounds                                        | Part Used         | Periodontal Mechanism of Action                                                                                                                                                                               |
|---------|----------------------------------------------|---------------------------------------|-------------------------------------------------------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Licorice ( <i>Glycyrrhiza glabra</i> )       | Fabaceae                              | Glycyrrhizin, glycyrrhetic acid, flavonoids, saponins                   | Root              | inhibiting COX and LOX pathways; downregulates IL-1 $\beta$ , TNF- $\alpha$ , IL-6; antioxidant and immunomodulatory effects.                                                                                 |
| 2       | Ginger ( <i>Zingiber officinale</i> )        | Zingiberaceae<br>Gingerols, shogaols, | Gingerols, shogaols, zingerone, essential oils, zingiberene, bisabolene | Rhizome           | Anti-inflammatory via COX and LOX inhibition.                                                                                                                                                                 |
| 3       | Barberry ( <i>Berberis vulgaris</i> L.)      | Berberidaceae                         | Berberine (alkaloid)                                                    | Root, bark, fruit | anti-inflammatory, anti-iNOS, anti-COX activity; modulates matrix metalloproteinases to reduce periodontal tissue destruction                                                                                 |
| 4       | Sage ( <i>Salvia officinalis</i> L.)         | Lamiaceae                             | Essential oils, flavonoids, phenolic compounds                          | Leaves            | Antibacterial, antifungal, antiviral actions; reduces gingival inflammation and edema; effective against gingivitis, stomatitis, and periodontal infections; improves gingival index when used as mouth rinse |
| 5       | Rosemary ( <i>Rosmarinus officinalis</i> L.) | Lamiaceae                             | Verbenone, $\alpha$ -pinene, borneol, 1,8-cineole, camphor              | Leaves            | Antibacterial and antifungal effects; antioxidant action; reduces dental biofilm and gingival bleeding; effective against persistent oral candidiasis                                                         |



| Sr. no. | Plant (Scientific name)                | Family        | Therapeutically Active Compounds                               | Part Used           | Periodontal Mechanism of Action                                                                                                                                                                                                                                           |
|---------|----------------------------------------|---------------|----------------------------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6       | Pomegranate ( <i>Punica granatum</i> ) | Lythraceae    | Punicalagins, ellagic acid, polyphenolic flavonoid             | Peel, fruit extract | Antibacterial and anti-biofilm activity; reduces gingival bleeding; antioxidant and anti-inflammatory effects; decreases salivary $\alpha$ -glucosidase; increases ceruloplasmin activity to strengthen oral antioxidant defenses                                         |
| 7       | Neem ( <i>Azadirachta indica</i> )     | Meliaceae     | Gallotannins, flavonoids, alkaloid                             | Twigs, leaves, bark | Mechanical plaque removal via chewing sticks; antibacterial against antibiotic-resistant periodontal pathogens; inhibits glucosyl transferase and bacterial adhesion; reduces plaque formation without causing gingival allergy                                           |
| 8       | Clove ( <i>Syzygium aromaticum</i> L.) | Myrtaceae     | Eugenol, eugenol dimers, volatile oils                         | Flower buds         | Antibacterial against <i>C. albicans</i> , <i>P. aeruginosa</i> , <i>S. aureus</i> , <i>E. coli</i> ; anti-inflammatory via COX-2 inhibition; analgesic and anticoagulant effects; inhibits prostaglandin synthesis and platelet aggregation; reduces oral microbial load |
| 9       | Tulsi ( <i>Ocimum sanctum</i> )        | Lamiaceae     | Eugenol, methyl eugenol, linolenic acid, essential oils        | Leaves              | anti-inflammatory action against PGE2 and leukotrienes; immunomodulatory effects enhance host resistance                                                                                                                                                                  |
| 10      | Turmeric                               | Zingiberaceae | Curcumin (diferuloylmethane), tumerone, atlantone, zingiberone | Rhizome             | Antibacterial against periodontal pathogens; reduces trypsin-like enzyme activity of red complex bacteria; anti-inflammatory and antioxidant actions; improves outcomes of SRP; reduces gingivitis and post-surgical inflammation                                         |

## CONCLUSION

Herbal remedies have been utilized all throughout the world to treat a variety of ailments because they are readily available, inexpensive, harmless, and effective. Herbal extracts are utilized in the form of gels, dentifrices, solutions, ointments, and other products to prevent and treat oral disorders. Because of their anti-inflammatory, antibacterial, antifungal, and antioxidative capabilities, phytochemicals found in herbal medicine can help prevent and treat gingivitis and periodontal disease. Dentists are attempting to find a new and effective treatment for such a terrible disease.

Studying previous treatment procedures can be useful in the field of dentistry.

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