

Herbal Formulations in Dentistry: Review.

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ABSTRACT

Aim: This article aims to review about the antimicrobial efficacy of different herbal formulations against various oral pathogens in Dentistry.

Background: Based on literature about ten essential oils were chosen for this study and their antimicrobial efficacy was evaluated on different oral microorganisms.

Review results: Different essential oil showed different results over oral bacteria. The most common oral bacteria on which effect was seen are *Streptococcus mutans*, *E. faecalis*, *Candida albicans* and *Porphyromonas gingivalis*.

Conclusion: Herbal formulations were found to be effective against oral microorganisms in dentistry.

Clinical Significance: This review provides an alternative approach for the treatment of dental diseases and periodontal issues.

Key words: Herbal formulations, Antimicrobial efficacy, Oral pathogens.

Introduction:

Herbal formulations are sources of natural products. These are extracted from plant materials such as seeds, buds, flowers, leaves, bark, twigs, herbs, fruits, woods and roots¹. For thousands of years they have been used in the management of microbial infections². A resistant and resilient microorganism constitutes to challenges in the therapy of various oro-microbial infections and because of rise in disease incidence, due to currently used antibiotics and chemotherapeutics, there is a global need for alternative products with antimicrobial properties to be used against these microorganisms³.

Endodontic infections are polymicrobial in nature and successful endodontic therapy is dependent upon the removal of these microorganisms⁴. Some of the microorganisms are highly resilient and persistent that in spite of thorough bio-mechanical preparation and extensive irrigation of root canal, there are cases of failure of endodontic therapy due to the entangled micro organisms in the root canal space⁵.

World Health Organization (WHO) has stated that about 80% of population depends upon natural formulations to get cure from various diseases because these are easily available, economic and have fewer side effects and India has a vast resource of these natural products because of its rich agriculture, ethnic biodiversity and variable climate³.

In past lot of research have been done to evaluate a wide variety of herbal formulations as an intra-canal medicament and irrigant against various microorganisms. So, the aim of this review article is to focus on various herbal formulations used in dentistry on various microorganism and to found out the most common microorganisms on which research has been done from past to present.

Background:

Based on literature total 10 essential oils were chosen for this study and their antimicrobial effect was seen on different oral microorganism:

Neem: Also known as *Azadirachta indica* is the most common medicinal plant found in Asian countries. It is anti-inflammatory, antibacterial and antifungal in nature⁶. Ghonmode WN et al (2013) conducted a study on antimicrobial efficacy on the extracts of neem leaves against *E. faecalis* and concluded that extract of neem leaf have significant antimicrobial properties against *E. faecalis*⁷. Raghavendra SS et al (2014) conducted a study on antifungal efficacy of neem leaf extracts and concluded that neem leaf extract have significant antifungal activity against *Candida albicans*⁸. Srichan R et al (2021) conducted a study to evaluate the antimicrobial efficacy of neem toothpaste against *Streptococcus mutans*, *Lactobacillus casei* and *Candida albicans* and concluded that Neem toothpaste was most effective against *L. casei* and *C. albicans* then *S. mutans*⁹.

Clove: Also known as *Syzygium aromaticum* is an aromatic plant from family Myrtaceae and native of Indonesia¹⁰. It has antifungal, antibacterial, antiviral, analgesic, antiplasmodial, antiinflammatory, antioxidant, anticancer, anti-ulcerogenic, antimutagenic and antigenotoxic properties¹¹. The main component of clove oil is eugenol, which is derived from the species name *Eugenia caryophyllata*¹². Also, United States Food and Drug Administration (FDA) has classified eugenol as 'generally recognized as safe (GRAS)'¹³. Shah A (2014) performed a study for the evaluation of antimicrobial efficacy for clove (alcoholic extract) at different concentrations such as 5%, 10% and 50%. Their result showed that at 5% concentration, extract of clove showed no antimicrobial activity while at 10% and 50% concentrations clove extract showed antimicrobial efficacy against *E. faecalis*. Thus, they concluded that clove had antimicrobial efficacy against *E. faecalis*¹⁴. Gupta C (2021) performed a study on comparative evaluation of antimicrobial and antifungal activity of clove oil and clove extract on different oral

microorganisms causing dental caries. Microorganisms chosen were *Streptococcus mutans*, *Halobacterium sp.*, *Lactobacillus sp.*, *Micrococcus sp.* and *Pseudomonas sp.* and seven fungal species were chosen *Aspergillus sp.*, *Aspergillus niger*, *A. fumigatus*, *Alternaria sp.*, *Rhizopus sp.*, *Rhizomucor sp.* and *Penicillium sp.* They concluded that both the clove oil and clove extract has broad spectrum of antimicrobial and antifungal activity against all the tested microorganisms¹⁵.

Tulsi: Tulsi (*Ocimum Sanctum*) is an aromatic shrub which belongs to the basil family of Lamiaceae (tribe ocimeae). Although it was founded first in northern central part of India, nowadays, it is grown throughout the eastern world tropical areas. In ancient ayurveda, Tulsi or *Ocimum Sanctum* is also known as “The Incomparable One,” “Mother Medicine of Nature” or “The Queen of Herbs,”¹⁶. It has large number of properties like antibacterial, anti-inflammatory, antiviral, anti-oxidant, antifungal, antiprotozoal, antimalarial and anthelmintic¹⁶. Chandrappa PM (2015) performed a study on the antibacterial efficacy of tulsi extract against *E. faecalis* and concluded that tulsi extract has significant antimicrobial properties against *E. faecalis*¹⁷. Pai KR (2022) performed a study to evaluate the antimicrobial efficacy of aqueous extract of *Ocimum sanctum* at three different concentrations (2%, 3% and 4%) against *Streptococcus mutans*, *Streptococcus sanguis*, *Streptococcus mitis* and *Lactobacillus acidophilus*. Their result showed that aqueous extract of *Ocimum sanctum* at 4% concentration showed maximum antimicrobial activity against all the four microorganisms although 3% and 2% were also effective. Maximum activity was present against *S. mutans* and *S. sanguis* with 4% extract. Hence, concluded that aqueous extract of *Ocimum sanctum* has antimicrobial efficacy against the microorganisms causing dental caries¹⁸.

Thyme: Also known as *Thymus vulgaris* is a shrub which can live for more than two years (perennial). It has aromatic leaves of a mixture of gray and green color from Lamiaceae family. Mainly originating from Southern part of Europe and from Countries bordering the areas of Mediterranean, nowadays it is available in many parts of the world which have moderate rainfalls or temperate climates¹⁹. It has antioxidant, anti-inflammatory, antibacterial, analgesic, antifungal, antiseptic, antispasmodic and antitumor properties²⁰.

Thosar NR (2018) performed a study on the evaluation and comparison of the antibacterial effect of the paste made of zinc oxide cement with thyme oil (ZO + Th oil) with that of zinc oxide cement with eugenol (ZO + E) paste against *Enterococcus faecalis*, *Staphylococcus aureus*, *Escherichia coli* and *Pseudomonas aeruginosa*. Antibacterial efficacy was checked by agar diffusion assay (in vitro method). Results showed that zones of bacterial inhibition were highest for zinc oxide cement with thyme oil against microorganisms *S. aureus* followed by *E. coli*, *E. faecalis* and *P. aeruginosa*. Thus, concluding, zinc oxide cement with thyme oil pastes showing higher levels of antibacterial efficacy against all microorganisms taken in the study as compared to zinc oxide cement with eugenol²¹. Abdel Hameed R et al (2020) conducted to evaluate the antimicrobial efficacy of thyme extract mouth rinse against chlorhexidine mouthwash on salivary

Streptococcus mutans count and concluded that thyme extract mouthwash was found to be a successful antimicrobial agent and significantly reduced the total bacterial count in the saliva of children as compared to Chlorhexidine²².

Tea tree oil: Tea tree is also known as *Melaleuca alternifolia* and its oil is made when its leaves are made to go through a process called steam distillation. Majorly, tea tree is grown in the swampy southeast coast part of Australia and it has properties like anticariogenic, antiplaque, anti-inflammatory, antimicrobial and antiviral²³. Souliassa AG (2020) conducted an in vitro study to evaluate the efficacy of tea tree oil against *Porphyromonas gingivalis* and *Aggregatibacter actinomycetemcomitans* biofilms and concluded that tea tree oil inhibits the adhesion of both the tested microorganism tested biofilms on the enamel surface and can be used as a for the treatment of oral diseases²⁴. Taalab MR (2021) performed a vivo study to check the efficacy of tea tree oil in periodontitis and concluded that intrapocket application of tea tree oil gel adjunctive to scaling and root planing (SRP) was effective against stage 2 (moderate) periodontitis²⁵.

Cinnamon oil: Various cinnamon species are used for extraction of cinnamon oil (*Cinnamomum* spp., Lauraceae family) such as *Cinnamomum aromaticum*, *Cinnamomum cassia*, *Cinnamomum burmannii* and *Cinnamomum loureiroi*. Its essential oil and extracts are obtained from various parts of cinnamon such as the flowers, leaves, fruits, bark, root bark and buds²⁶. Panchal V et al (2018) conducted a study on the comparison of antimicrobial efficiency of cinnamon extract and calcium hydroxide as intracanal medicament against *Enterococcus faecalis* and concluded that cinnamon extract was found to have better antimicrobial properties against *E. faecalis* as compared to calcium hydroxide²⁷. Gandhi HA et al (2020) conducted a study on the comparison of the antibacterial efficacy on the bark oil of with probiotic blend of *Lactobacillus plantarum* and *Lactobacillus rhamnosus* against salivary *Streptococcus mutans* and concluded that both the cinnamon bark oil and probiotic blend have strong antibacterial efficacy against salivary *Streptococcus mutans*²⁸.

Lemongrass oil: Lemongrass is a plant which belongs to the Family: *Poaceae* and Genus: *Cymbopogon*. Some other common names of Lemongrass are Hierba luisa, Barbed wire grass, Tanglad, and Citronella grass. *Cymbopogon nardus* and *Citratum* is its scientific name and it is widely distributed all over India, Tropical Asia and Africa. Lemongrass oil and extract can be used in all types of dental diseases and it has anti-inflammatory, anti-bacterial, anti-proliferative, anti-fungal, anti-viral and anti-oxidant properties²⁹. Ambade S et al (2022) conducted a study on the evaluation of antimicrobial and anti-biofilm activity of lemongrass essential oil based mouthwash against *S. mutans* and *L. acidophilus* oral bacteria and concluded that the mouth wash containing lemongrass essential oil was found to have stable physical and chemical properties and was found to be safe without any cytotoxic activity. Also mouthwash containing lemongrass essential oil was found to have appreciable antimicrobial and anti-biofilm activity

against the oral microorganisms taken in the study³⁰. Aishwarya RP (2022) performed a study on the investigation of the antifungal activity of lemongrass oil against the presence of *Candida Albicans* over denture reliners and they concluded that lemongrass essential oil was found to have effective antifungal properties against *C. Albicans* and it removed the biofilm of *C. Albicans* over soft reliners at very low concentrations without altering the hardness³¹.

Eucalyptus oil: *Eucalyptus globulus* of family Myrtaceae, also known as Blue Gum, is the main source of eucalyptus oil. Though it is a native of Australia, its cultivation is done all around the world³². It has antimicrobial, anti-inflammatory, analgesic and antifungal properties³³. Clavijo-Romero A (2019) performed a study on the evaluation of the antimicrobial efficacy of the Eucalyptus oil against *S. aureus*, *E. coli* and *P. aeruginosa* and concluded that Eucalyptus essential oil has strong antimicrobial efficacy against *S. aureus*, *E. coli* and *P. aeruginosa*³⁴. Muller-Heupt LK (2022) performed a study on the evaluation of antimicrobial efficacy of Eucalyptus globulus leaf extract against Porphyromonas gingivalis and concluded that extract of *E. globulus* showed antimicrobial efficacy against *P. gingivalis*, making it a promising alternative for the treatment of periodontal diseases³⁵.

Peppermint oil: Also known as *Mentha piperita* (L.) of family Labiatae (Lamiaceae), is largely grown in moderate rainfall areas or temperate areas of the Northern part of America, North Africa and Europe. But nowadays it is cultivated in all the regions of world. Peppermint is a sterile hybrid of species *Mentha aquatica* L. and *Mentha spicata*, L. and very important aromatic herb containing high level of volatile oil used in dental care. The peppermint leaves have a characteristic strong aromatic odor and a warm aromatic pungent taste followed by a cooling sensation. It has antiseptic, antiviral, antibacterial, antioxidant, antifungal and antispasmodic effects³⁶. Manoj Kumar KR (2017) conducted a study to determine the antimicrobial efficacy of peppermint oil against isolates of Enterococcus faecalis from dental caries and concluded that peppermint oil has antimicrobial efficacy against *E. faecalis*³⁷. Park CM and Yoon HS (2018) performed a study on the evaluation of the antimicrobial efficiency of peppermint essential oil and lavender essential oil and concluded that both the oils showed good antimicrobial efficacy but peppermint oil showed greater antimicrobial efficacy after 24 hours than lavender oil against *Streptococcus mutans*³⁸.

Oregano oil: Also known as *Oreganum vulgare*, it belongs to Lamiaceae family, *Oreganum* genera and *Vulgare* species) is a natural herb which grows in different parts of Europe and Asia. In India it is found in the regions of the Himalayas. Carvacrol (5-Isopropyl-2-methylphenol) is a monoterpene phenol and a primary compound of oregano essential oil³⁹. This consists of antioxidant, anti-inflammatory, antidiabetic and cancer suppressor properties⁴⁰. Teja KV et al (2021) conducted a study on comparative evaluation of the antimicrobial efficacy of 0.2% oregano oil with some other intracanal medicaments used in disinfection of dentin tubules contaminated with Enterococcus faecalis and concluded that 0.2% oregano oil was shown to

have better disinfection properties against *E. faecalis* in respect to other tested irrigants⁴¹. Janani K (2021) performed a study on the evaluation of the antibacterial activity of oregano oil with some other intracanal medicaments against *Enterococcus faecalis* and concluded that oregano essential oil has shown similar antimicrobial efficacy as calcium hydroxide against *E. faecalis*⁴².

Review results: Total ten and most common essential oils have been covered in this review. The review results showed that **Neem** whose leaves are most commonly used for the treatment in any kind of infection in Ayurveda has both the antimicrobial properties against most common oral pathogens such as *Streptococcus mutans*, *E. faecalis* and *Lactobacillus casei* and antifungal properties against *Candida albicans*.

Tulsi (The Queen of Herbs) was also found to be effective against *Streptococcus mutans*, *Enterococcus faecalis*, *Streptococcus sanguis*, *Streptococcus mitis*, *Lactobacillus acidophilus* and *S. sanguis*. **Clove** which is also used in Dentistry by the name of eugenol oil was also found to be effective against various oral pathogens such as *Enterococcus faecalis*, *Streptococcus mutans*, *Halobacterium sp.*, *Lactobacillus sp.*, *Micrococcus sp.* and *Pseudomonas sp.* and was found to have antifungal properties against *Aspergillus sp.*, *Aspergillus niger*, *A. fumigatus*, *Alternaria sp.*, *Rhizopus sp.*, *Rhizomucor sp.* and *Penicillium sp.* **Thyme** or *Thymus vulgaris* which is also known as culinary herb was also found to be effective against *Enterococcus faecalis*, *Staphylococcus aureus*, *Escherichia coli* and *Pseudomonas aeruginosa*. **Tea tree oil** or *Melaleuca* oil was found to be more effective against microorganism causing periodontitis such as *Porphyromonas gingivalis* and *Aggregatibacter actinomycetemcomitans*. **Cinnamon oil and Peppermint oil**, both were found to be effective against *Enterococcus faecalis* and *Streptococcus mutans* and **Oregano oil** was found to be more effective against *Enterococcus faecalis* only. **Lemongrass oil** was found to be effective against *Streptococcus mutans*, *L. acidophilus* and *C. Albicans*. Lastly, **Eucalyptus oil** was found to be more effective against *S. aureus*, *E. coli*, *P. aeruginosa* and *Porphyromonas gingivalis*

Conclusion:

This review has been done to assess the research on the antimicrobial efficacy of different herbal extracts against dental caries and periodontal pathogens and it is expected that it will be successful in identifying new dental materials with different antimicrobial activity, especially in the scenario of rapidly emerging drug-resistant microorganisms. So, there is need to produce different and more effective antimicrobial agents and there is need for more research in this area to aid in the development of effective and innovative methods that can simultaneously inhibit the growth of most common dental diseases in human beings and can also slow down the development of bacterial resistance towards the drugs.

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