

Essential Oils And Their Uses In Dentistry - A Review

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Abstract

Oral health plays a significant role in the overall well-being of humans. According to the latest WHO study, oral diseases are the most commonly existing diseases in society, which cause discomfort, pain, loss of teeth, and even death in a few cases. Dental diseases are classified as dental caries, periodontal diseases, gingivitis, plaque, dental pain. Essential oils obtained from Clove, lavender, cinnamon, eucalyptus, lemon, tea tree, coconut, spearmint has been reported to possess significant therapeutic efficacy in dental diseases. Essential oils are frequently used for the treatment of oral diseases because of their antimicrobial and anti-inflammatory properties.

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I. Introduction

Dental medicine is one of the fields of medicine where the most common pathologies are of bacterial and fungal origins. Preventive medicine relies mostly upon reducing the bacterial biofilm via oral hygiene. The most often used active ingredients in mouth rinses and toothpastes are chlorhexidine, hyaluronic acid, and fluorides. Although effective, chemical products may have some clinical disadvantages: teeth discoloration, taste alterations, mouth dryness, supragingival calculus accumulation, and oral mucosal lesions. The attention of many researchers has focused on the antimicrobial properties of traditional medical substances, like essential oils (EOs). EOs and extracts have demonstrated effective antibacterial and antifungal properties. In the field of dental medicine, oral hygiene products based on herbal extracts are well-known. This article aims to explore the wide and interesting world of Essential oils and their myriad uses both traditional and new.

II. Methodology

The medline, PubMed and Google Scholar databases were electronically investigated for pertinent articles available in English using the key words essential oils, clove oil, cinnamon oil, coconut oil, lemon oil, mint oil, lavender oil, dentistry. Finally 75 articles were selected.

Essential oils are plant extracts that have been used for treatment of various medical and dental problems since ancient times. These are secondary metabolites produced by various medicinal plants and possess antibacterial, antifungal, and antioxidant properties^[1] lavender oil, eucalyptus oil, clove oil, cinnamon oil, and lemon EO are commonly used across the world for their health benefits.

EOs are secondary metabolites of plants whose constituents are basically a complex mixture of terpenic hydrocarbons, especially monoterpenes and sesquiterpenes, and oxygenated derivatives such as aldehydes, ketones, epoxides, alcohols, and esters.^[2] EOs greatly differ in their compositions. Even the composition of EOs extracted from the plants of same species differ in different geographic locations. Composition also depends on the maturity of the plant from which the EOs are extracted.

Membrane damage is proposed to be the main mechanism of action.^[3] Solubility of EOs in the phospholipid bilayer of cell membranes seems to have an important role in their antimicrobial activity. Clove oil has reported to reduce the quantity of ergosterol which is found specifically in fungal cell membrane Terpenoids in EOs have been found to interfere with the enzymatic reactions of energy metabolism.^[3,4]

Lavender oil It can be used in dental clinics to reduce patients' anxiety. It is found to be useful as an anxiolytic agent when used in waiting area. The studies performed showed statistically significant reduction in anxiety

scores when the fragrance of lavender oil was used at the reception area. It is also helpful during surgical procedures, as it has been shown to reduce the pain of needle insertion.¹⁵ An oral preparation called silexan which is formulated with lavender oil has been proven effective in treating anxiety disorders.¹⁶

Eucalyptus oil

Essential oil extracts of Eucalyptus possess central and peripheral analgesic effects as well as neutrophil-dependent and independent anti-inflammatory activities.

It shows an inhibitory effect on oral pathogens like *Lactobacillus acidophilus*, which makes this suitable to be used as an anticariogenic agent.¹⁷ Alshabel et al compared the antimicrobial effect of mixture of zinc oxide eucalyptus oil with zinc oxide eugenol, and Metapex. The inhibition zones of zinc oxide eucalyptus mixture and zinc oxide eugenol against *C. albicans* and Streptococci were almost near to each other with statistically non-significant differences. While Metapex showed lowest inhibition zones with highly significant difference when compared to zinc oxide eucalyptus mixture and zinc oxide eugenol against both microorganisms. Zinc oxide eucalyptus mixture showed almost similar antimicrobial effect to zinc oxide eugenol, while Metapex revealed lowest antimicrobial effect.¹⁸

Tanaka et al conducted a study on the effect of eucalyptus extract chewing gum on oral malodour. Eucalyptus gum was effective in reducing tongue coating bacteria.¹⁹

Peppermint oil/ Spearmint oil

Peppermint (*Menthapiperita*) oil is one of the most popular and widely used essential oil and menthol is the major compound, followed by menthyl acetate and menthofuran. Peppermint oil is antibacterial and shows an inhibitory effect on the proliferation of staphylococci. It's also antifungal and exhibit fungicidal activities against both the standard and clinical strains of *Candida* species and against the azole-resistant and azolesusceptible strains.¹⁰

Spearmint Oil is separated by the bright green *Menthaspicata* herb (Family: Lamiaceae). The primary constituents are carvyl acetate, carvone, 1,8 cineol, cis-carveol, cissabinene hydrate limonene, and cisdihydrocarvone. Because of its good, minty flavor and potential to encourage fresh breath, spearmint is being commonly used for sweets, gums, and oral hygiene products. Spearmint oil is a moderately severe substitute to some of the more strong mint oils, but it also supplies the mouth with effective soothing and relaxing properties

Tea tree oil

TTO and some of its individual components, specifically terpinen-4-ol, exhibit strong antimicrobial efficacy against fungal biofilms. TTO can be a solution for the increasing resistance of *C. albicans* to established antifungal drugs. It can be used to treat oral candidiasis¹¹ and is suitable for use in prophylactic oral hygiene products. The study performed by Ramage *et al.* shows that it is more appropriate and safe to use terpinen-4-ol, the major component of TTO, than TTO itself.¹² TTO has been shown to possess a number of therapeutic properties, including anti-inflammatory activities and there is current interest in its possible antitumor properties. However, it is best known for its antimicrobial activity against a wide spectrum of microorganisms, for example *Staphylococcus aureus*, a range of oral bacteria, and certain viruses, including herpes simplex and influenza viruses.¹³ TTO also has potent activity against many fungi, including some azoleresistant yeasts and there is some evidence for its efficacy in treating fluconazole refractory oral candidosis in AIDS patients. This raises the possibility of using TTO preparations for the prevention and treatment of oral candidal infections. Oral care products are now available containing TTO including an alcohol-free mouthwash¹⁴. A tea tree oil gel also reduced candidal colonies in orthodontic patients.¹⁵

Cinnamon oil

Cinnamon is a widely known culinary herb and traditionally used in medicine applications. Its antiinflammatory, cardioprotective, antioxidative, and antimicrobial properties have also been researched.¹⁶ Thus, cinnamon EO, cinnamon extracts, and pure compounds, due to their antibacterial, antifungal, and other properties, have potential uses in mouth rinses, toothpastes, or as a root canal irrigant, showing promise as an antimicrobial agent in dentistry. Cinnamon (*Cinnamomum* spp., Lauraceae family) includes more than 250 evergreen trees spread mainly in Asia, China, and Australia¹⁷. Many species have been studied in the literature, and some of them in the field of dental medicine. Two of the most studied types of cinnamon are *Cinnamomum verum* or *Cinnamomum zeylanicum* (true cinnamon, Ceylon cinnamon, or Mexican cinnamon). *C. verum*'s older botanical name, *C. zeylanicum*, derives from Sri Lanka's older name, Ceylon. Well-studied is also *Cinnamomum aromaticum* or *Cinnamomum cassia* (Cassia cinnamon or Chinese cinnamon). The other two main species of cinnamon are *Cinnamomum burmannii* (also called Korintje, Java, or Indonesian cinnamon) and *Cinnamomum loureiroi* (Vietnamese or Saigon cinnamon). EOs and extracts have been isolated from the

different parts of cinnamon, such as the leaves, bark, fruits, root bark, flowers, and buds. More than 80 compounds have been identified, and the compositions vary due to many factors¹⁸. The main components of cinnamon EOs and extracts are cinnamaldehyde, eugenol, phenol, and linalool.

Both oil and pure cinnamaldehyde of *C. cassia* are found to be equally effective in inhibiting the growth of various isolates of bacteria including Gram-positive *Staphylococcus aureus*, and Gram-negative *E. coli*, *Enterobacter aerogenes*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Vibrio cholerae*, *Vibrio parahaemolyticus* and *Salmonellatyphimurium*, and fungi including yeasts including four species of *Candida*, *C. albicans*, *C. tropicalis*, *C. glabrata*, and *C. krusei*.¹⁶

Wiwattanarattanabut et al. reported good antimicrobial properties of cinnamon EO (*C. zeylanicum*) against two cariogenic bacteria: *S. mutans* KPSK and *Lactobacillus casei*.¹⁹ A 24-h exposure to cinnamon EO reduced the biofilm mass by approximately 80%. Bacterial film reduction was also reported on implant surfaces²⁰. The inhibitory effect of EO obtained from *C. cassia* bark added to a toothpaste against *S. mutans* was reported by Karadağlıoğlu et al.²¹ Cinnamon EO showed the highest antibacterial activity against *S. mutans* among eight other EOs tested, including lime, spearmint, wintergreen, peppermint, lemongrass, cedarwood, clove, and eucalyptus Eos.²² Cinnamon EO and the triple antibiotic paste used in the study were able to eliminate planktonic *E. faecalis* after 4 and 24 h, while calcium hydroxide paste failed to do so. Cinnamon EO showed better biocompatibility with experimental fibroblast cells in comparison to the other two substances.²³ The effect of cinnamon EO as a root canal irrigant is weaker than 3% NaOCl but could lead to 80–85% intracanal bacterial reduction²⁴. A 20% ethanolic extract of *C. zeylanicum* was found to be even more effective against *E. faecalis* as compared to 3% NaOCl or neem extract.²⁵

The plaque reductive and anti-inflammatory effects of cinnamon extract were studied in comparison to chlorhexidine mouthwash. Although chlorhexidine showed the maximum decrease in both plaque and gingival scores, the cinnamon extract's effects were statistically insignificant²⁴.

Xu patented a method for the production of chewing gum for the prevention and cure of decayed tooth and periodontitis with one of the active ingredients being *Cinnamomumjaponese* extract²⁶. Studies conducted on cinnamon EO concluded that it is safe to be used in healthy patients with dentures for the treatment of oral candidiasis.²⁷

Lemon EO

The lemon essential oil is derived from the Rutaceae family of *Citrus limonum* (also known as *Citrus Limon*). Lemon oil contains aldehydes, terpenes, esters, and sesquiterpenes. By killing bacteria, lemon oil help to avoid dental cavity and receding gums. Other characteristics of lemon oil are believed to promote the growth of tissue and can encourage healthier gums. It serves as a natural treatment for many oral disorders, such as oral thrush and bad breath, because lemon essential oil has antibacterial and anti-fungal properties. It could also be used to naturally whiten the teeth and avoid dental decay.²⁸ Terpenes, d-limonene and l-limonene Lemon oil can help prevent receding gums and tooth decay by fighting against bacteria

Lemongrass essential oil gel as a local drug delivery agent for the treatment of periodontitis Phytoscience study has discovered a modern alternative of optional antimicrobial therapy provided by different medicinal plants. A traditional medicine plant is (lemongrass). Lemongrass natural oil prevents the production of many forms of microbes, namely periodontal bacteria, at a concentration of about 2 percent. *Cymbopogonflexuosus* Lemongrass oil was compared with that of chlorhexidine mouthwash and showed better efficacy in gingivitis and plaque reduction.²⁹

At a concentration of 2% essential oils, a mouth rinse formulation based on essential oils of lime (*C. aurantifolia*) peel begins to inhibit the growth of *S. mutans*.³⁰ Myung-Haeng et al. an essential oil mixture of diluted tea tree, peppermint, and lemon, can be an efficient way to reduce malodor and VSC (volatile sulfur compounds) in intensive care units.³¹

Lemon EO is suggested to be used as an effective remedy against candidiasis caused by *C. albicans*.³² Naser et al conducted study to discover the best concentrations of lemongrass essential oil (LGEO) that are effective for inhibiting *C. albicans* growth for addition to the heat-cured soft denture liner materials. The results of their work show that LGEO is a potent antifungal substance that may be effectively incorporated into soft liners to create materials that are effective against *C. albicans* fungi.³³

Clove oil Clove (commonly called as “lavangam” in Tamil) is the oldest spice which has been in use for many years. It was used in China for more than 2000 years for checking decay of the tooth and also for halitosis (bad breath). The oldest records of clove being used in china for medicinal property were as early as 240AD. It is a tree with a height ranging from 10 to 20 meters which is growing in islands of Indonesia, Tanzania, Sri Lanka Madagascar, India and Malaysia.³⁴ Records say that clove was one of the spice traded first, and the evidence of these were found in the vessels which dated back 1721 BC , native to Malucca islands. For Romans cloves were

the treasured commodity. The Chinese people were also using clove from 226 BC. Cloves were the precious spices of the 16th and 17th century. By the end of 18th century the spice spread to other parts of the world like Zanzibar, Madagascar, Brazil, Mauritius, Ternate, Tidore, and Tanzania. Clove is used as a spice in foods in India. It relieves stomach pain, nausea and vomiting. Clove has a deodorizing property and so used in perfumes and in cosmetics. It shows analgesic activity in people suffering from tooth pain.³⁵ Clove oil is obtained by distillation of the leaves, flowers, buds and stem of the clove tree. The main component of the clove oil is the eugenol which acts as an anesthetic, analgesic, anti-inflammatory activity. Stress which is very common in every individual can also be relieved with the help of hydro-alcoholic extracts of clove oil.³⁶ Because of its antioxidant activity it serves in the prevention of cancer.

Clove contains 14-20% of volatile oil that includes eugenol, acetyleugenol, sesquiterpenes (α - and β -caryophyllenes) and small quantities of esters, ketones and alcohol. Clove also contains tannins, sitosterol and stigmasterol. Oils of clove can be rubbed against the sore tooth or gums to relieve toothache, and whole clove can be chewed to control bad breath. The oil extracted from a clove is known as eugenol. Depending on where the oil is extracted from either the bud, leaf, or stem. The concentration of eugenol generally ranges from 60 to 90%. Clove oil is generally used in dentistry to treat pain from a dry socket, as well as used in a number of temporary restorative materials.^{35,37}

There are three types of clove oil:

Bud oil is derived from the flower-buds of *S. aromaticum*. It consists of 60–90% eugenol, eugenyl acetate, caryophyllene and other minor constituents.

Leaf oil is derived from the leaves of *S. aromaticum*. It consists of 82–88% eugenol with little or no eugenyl acetate, and minor constituents.

Stem oil is derived from the twigs of *S. aromaticum*. It consists of 90–95% eugenol, with other minor constituents.

Antibacterial

Clove oil shows antimicrobial activity against *Actinobacillus actinomycetemcomitans*, *Capnocytophaga gingivalis*, *Fusobacterium nucleatum*, *Porphyromonas gingivalis*, *Prevotella intermedia*, *Prevotella melaninogenica*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Candida albicans*, *Escherichia coli*. The antimicrobial action observed for the clove oil suggests its usage as an adjuvant to periodontal therapy.^{38,39} A study tested the antimicrobial activity of different Indian spice plants as mint, cinnamon, mustard, ginger, garlic and clove. The only sample that showed complete bactericidal effect against all the food-borne pathogens tested *Escherichia coli* (*E. coli*), *Staphylococcus aureus* and *Bacillus cereus* was the aqueous extract of clove at 3%. At the concentration of 1% clove extract also showed good inhibitory action.⁴⁰

Hosseini et al demonstrated the analgesic property of clove oil on mice and then concluded that Eugenol depresses the action potential of A and C fibres and also inhibits Na⁺ currents in the nerve root ganglion, which explains its analgesic property.⁴¹ Other studies show that clove oil will predominantly block the peripheral pain mechanism and the eugenol present in the clove oil is also believed to depress the sensory receptors of pain. Using clove oil will reduce the pain and also helps in the removal of infection from the abscess.⁴²

Clove oil possess the antioxidant property and so can effectively reduce the levels of the free radicals present in the oral cavity. Clove oil can be a short term remedy for halitosis since it is anti-microbial, but cannot be used long term because it lacks the pro-biotic activity.⁴³ The Chinese used cloves to get rid of halitosis. Clove oil in the form of clove paste in Aphthous Ulcer treatment acts as a biocide being active against invasive bacteria, fungi and even invading larvae.^{44,45} Clove oil helps in the reduction of amount of plaque deposition on oral hard tissues.⁴⁶ Clove extracts help reduce root canal microflora.⁴⁷ Clove has shown antibacterial activity against *S. mutans* and *Enterococcus faecalis*.⁴⁸

Coconut oil

Coconut oil is an edible oil and is consumed as a part of the staple diet in many tropical countries. Coconut oil is a highly desired and easily available oil in India. It is used in cooking and for its cosmetic properties. Coconut oil is an edible oil extracted from coconut meat, and is one of the world's richest plant-based sources of saturated fat.

Coconut oil is different from most other dietary oils because the predominant composition of coconut oil is a medium chain fatty acid, whereas in the majority of other oils the basic building blocks are almost entirely long chain fatty acids. This influences the physical and chemical properties of the oil. Coconut oil contains 92% saturated acids, approximately 50% of which is lauric acid. Human breast milk is the only other

naturally occurring substance with such a high concentration of lauric acid. Lauric acid has proven antiinflammatory effects and antimicrobial effects.⁵⁰

The main type of fat in coconut oil is lauric acid, which is a 12 carbon (C12) medium-chain triglyceride (MCT), and makes up around half of coconut oil. It also contains small amounts of palmitic (C16) and myristic (C14) acid

Ayurvedic medicine has used coconut oil as an antimicrobial for centuries to promote dental health through a process known as “oil pulling,” which is believed to rid the mouth of bacteria that lead to tooth decay and bad breath.⁵¹

In oil pulling, as the oil is swished in the mouth the mechanical shear forces exerted on the oil leads to its emulsification and the surface area of the oil is greatly increased. The oil film thus formed on the surface of the teeth and the gingiva can reduce plaque adhesion and bacterial co aggregation.

It was also proposed that the alkalis in the saliva can react with the oil leading to saponification and formation of a soap like substance which can reduce the adhesion of plaque. Coconut oil has a high saponification value and is one of the most commonly used oil in making soaps. The soaps produced with coconut oil can lather well and have an increased cleansing action.^{53,54} The lauric acid in the coconut oil can easily react with sodium hydroxide in saliva during oil pulling to form sodium laureate, the main constituent of soap which might be responsible for the cleansing action and decreased plaque accumulation.

The antimicrobial activity is attributed to the presence of monolaurin in coconut oil. It is shown to have significant antimicrobial activity against *Escherichia vulneris*, *Enterobacter spp.*, *Helicobacter pylori*, *Staphylococcus aureus*, *Candida spp.*, including *C. albicans*, *C. glabrata*, *C. tropicalis*, *C. parapsilosis*, *C. stellatoidea* and *C. krusei*. Studies also show that coconut oil is affective against *S. mutans* and *C. albicans* in an *in vitro* oral biofilm model.⁵⁵

One study comparing the chlorhexidine mouthwash to coconut oil pulling found no statistical difference compared to the use of coconut oil pulling for plaque score; gingival index score and bleeding-onprobing. Predictably, there was a significant difference in staining when comparing these two groups. As a well understood side effect of chlorhexidine, hard-tissue staining poses an issue for both patients and for dental care professionals with regards to removal.⁵⁶

Peedikayil et al conducted a study on fifty female children aged 8–12. The participants were asked to routinely perform oil swishing with coconut oil and chlorhexidine and rinse every day in the morning after brushing for 2–3 minutes. *S. mutans* in saliva and plaque were determined using a chairside method, i.e., the Dentocult SM Strip Mutans test. Patients were instructed to continue oil swishing for 30 days. The results showed that there is a statistically significant decrease in *S. mutans*. count from coconut oil as well as chlorhexidine group from baseline to 30 days. The study also showed that in comparison of coconut oil and chlorhexidine there is no statistically significant change regarding the antibacterial efficacy.⁵⁷ Similar results were obtained by other studies.⁵⁸ Jauhari et al compared the efficacy of coconut oil pulling with fluoride mouthrinse and found it to be effective.⁵⁹

In a study aimed at isolating *Candida* species in children with ECC and at studying the antifungal effect of coconut oil, probiotics, *Lactobacillus*, and 0.2% chlorhexidine on *C. albicans* in comparison with ketoconazole in children sufferiangfromECC. Chlorhexidine and coconut oil have shown significant antifungal activity which is comparable with ketoconazole.⁶⁰

Oregano Oil

Oregano is the name used to refer to a great variety of plants that share a particular flavor and odor . At least 61 species and 17 genera belonging to six different botanical families are known as oregano. Verbenaceae and Lamiaceae are the most conspicuous families due to their economic importance. Within the Lamiaceae family are the plants belonging to the genera *Origanum* and *Hedeoma*; while the genera *Lippia* and *Lantana* belong to the Verbenaceae family. The other families are Rubiaceae, Apiaceae and Asteraceae . *Hedeoma patens*, *Lippiagraveolens*, *Lippiapalmeri*, *Lippia alba*, *Origanumdictamnus*, *Origanumhirtum*, *Origanumonites*, *Origanumvulgare* are some examples of oregano species producing Eos.^{61,62,63}

Oregano oil, extracted from the leaves of the oregano plant (*Origanumvulgare*), is rich in phenolic and trepenoid compounds. Components such as thymol, carvacrol and rosmarinic acid are abundant in the oil. These exhibit excellent antibacterial, antifungal and antiviral effects as well as powerful antioxidant activity.⁶⁴ These characteristics make it a wonderful natural remedy that contributes to oral health. the constituents and concentration of the compounds of the EOO usually vary due to a great diversity of factors such as species, pests, soil conditions, harvest season, geographical location, climatic and growth conditions. The drying method of the oregano, the extraction technique and the anatomical part of the plant used for extraction also influence the EO yield and composition.⁶⁵

Because of the radical scavenging ability of the EOO, it has been reported that these compounds can be used as a health promoting substances in the prevention of chronic diseases and neurodegenerative disorders, which are linked to oxidative stress. Antioxidant properties from EOO offers the possibility of using these oils as preservatives and flavor for food or nutraceutical products. In a 2021 research study,⁶⁶ the researchers found that naturally occurring phytochemical agents in oregano oil, thymol and carvacrol, were the main components which were responsible for oregano oil's antioxidative, antibacterial and antifungal effects. The main component of oregano oil (over 60%) is carvacrol, a potent monoterpenoid phenol.

According to the research results, oregano oil showed very good antimicrobial activity against all four oral pathogens chosen for the study (*Streptococcus mutans*, *Staphylococcus aureus*, *Enterococcus faecalis*, *Candida albicans*).⁶⁷

The antibacterial action of oregano oil for teeth can help eliminate the bacteria responsible for bad breath orhalitosis.

Muhammad et al conducted a study to evaluate the efficacy of mouthwash containing oregano essential oil in the reduction of oral halitosis compared to Chlorhexidine and distilled water. A clinical trial was conducted on 54 dental students with oral halitosis. They were randomly allocated into 3 groups (Oregano, Chlorhexidine and placebo) and instructed to rinse with 15 ml of the assigned mouthwash twice daily for 7 days. Halitosis was measured using two organoleptic methods and BANA (N-benzoyl-DL-arginine-naphthylamide) test at baseline and after 7 days. Both Chlorhexidine and Oregano Groups showed significant reduction of Organoleptic tongue and floss scores and BANA test scores after 7 days while no significant difference was found in placebo group. There was no significant difference in all measurements between Chlorhexidine and Oregano group after 7 days. The inhibitory effect of Carvacrol against oral and periodontal pathogens has been demonstrated by many studies.⁶⁷ In vitro study showed that carvacrol at concentration of 1% inhibited the growth of *Porphyromonasgingivalis* which might explain the reduction in the result of BANA test.⁶⁸

Toothache relief

The analgesic and anti-inflammatory properties of oregano oil may provide temporary relief from toothache. Thymol and carvacrol was reported to inhibit inflammation and ulcer formation. According to a study mixing oregano essential oil with a small amount of olive oil could be effective for relieving toothaches and other types of oral pain.³

Anticaries

Oregano oil for teeth can help prevent cavities by fighting the bacteria that contribute to their development. Badekova et al conducted a preclinical study lasting 105 days. They formulated an anti-caries gel with oregano extract and essential oil. They concluded that *O. vulgare* essential oil inhibited the growth of *S. mutans* biofilm by 98% compared with unexposed control bacteria.⁶⁹ Oregano essential oil and its main components have been shown to have high antibiotic film and antibacterial properties and can be used to produce new plant-based preparations.⁷⁰

O. vulgare was found to manifest antimicrobial activity against a wide range of bacteria, including antibiotic-resistant species. Moreover, it is able to affect gram-positive and gram-negative bacteria, and yeast fungus.⁷¹

Carvalho et al conducted a study to determine the antibacterial and antibiofilm effects of essential oils and herbal toothpastes against bacteria associated with oral diseases. The minimum inhibitory concentration (MIC) and antibiofilm activity of 13 essential oils against *Staphylococcus aureus*, *Streptococcus mutans*, *Lactobacillus lactis*, and *Enterococcus faecalis*. were determined. Toothpastes were formulated with different concentrations of the most active essential oils, alone and in combination, and evaluated for antibacterial and antibiofilm activities. Clove, oregano, thyme, and cinnamon essential oils were effective in inhibiting all bacterial strains. Toothpastes containing clove, clove and oregano, or clove, oregano, thyme, and cinnamon essential oils were able to completely disrupt *S. mutans* biofilms, not differing from the control. Thyme essential oil was found to act synergistically with chlorhexidine against *S. mutans*. The results indicated that clove, oregano, thyme, and cinnamon essential oils may be added to fluoride-free toothpastes to enhance inhibitory effects against bacteria associated with cavities and periodontal disease.⁷²

Essential oil of oregano and its main constituents had potent anti-biofilm and antibacterial properties and could be utilized for the production of new plant-based mouthwashes.⁷³

Endodontic medicament

A significant reduction of LPS-induced osteoclastic cells was evident when 100 ng/ml of oregano essential oil extract was used. The results of the study infer that, as the concentration of the oregano essential oil increases, reduction of osteoclastic cells occurs. Therefore, it can be concluded that oregano essential oil extract

can be utilized as a therapeutic agent targeting LPS- induced osteoclastogenesis. Hence, these preliminary, in vitro study results can be a foundation for conducting randomized controlled trials on the retardation of periapical bone resorption in endodontic infections.⁷⁴

Mouthwash with oregano oil

Mix 4-5 drops of oregano essential oil in a glass of water. Swish the solution in the mouth for about 30 seconds and then spit it out. Finish by rinsing with water.

For gum treatment or relief from pain oregano oil needs to be diluted with a carrier oil, such as coconut oil, to avoid any skin irritation. The diluted oil needs to be massaged into gums, using a clean finger or cotton swab. After 2-3min it is rinsed out.

Combination of EOs

Combining EOs and antibiotics can reduce antibiotic resistance in multidrug-resistant bacteria. Peppermint, cinnamon bark, and lavender EOs were found to be antibiotic resistance-modifying agents, when used in combination with piperacillin.

The first technique of using essential oils is a topical treatment, i.e., applying essential oils on the body's nails, skin, teeth, mouth, hair, or mucous membranes. This requires direct implementation, massage, hot compresses, and the incorporation of oils into bathwater. The process of oil pulling is one method of topical application; oils are scooped for 5-20 minutes in the mouth. When essential oils are introduced into the methods of oil-pulling, they are applied to some other oil, such as olive oil or coconut. Both methods have shown beneficial effects.

Different researchers across the world have been studying and attempting to incorporate various essential oils in oral health care products like mouthwashes, lozenges, gargles, chewing gums, toothpaste.

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