

Lemongrass in dental health

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ABSTRACT

Lemongrass is also known as *Cymbopogon citratus* which is an herb which belongs to the grass family of Poaceae. Lemongrass offers a wide array of medicinal benefit. It is well known for its antibacterial, antifungal, and antimicrobial properties. Since lemongrass oil possesses various pharmacological actions, it is quite useful in both the medical and dental field. The health benefits of lemongrass in the medical field include relief from stomach disorders, insomnia, respiratory disorders, fever, aches, infections, and rheumatism. The defensive antioxidant activity of the lemongrass herb protects against antibiotic-resistant *Staphylococcus aureus* and helps in maintaining optimum cholesterol levels, cellular health, nervous system, healthy skin, and immune system. Besides that, in the dental field, the lemongrass helps by removing bacteria from the oral cavity and prevents teeth and gum diseases. It also had antioxidant properties which help to treat and prevent periodontitis.

KEY WORDS: Antibacterial, Antifungal, Antimicrobial, Essential oil extract, Lemongrass

INTRODUCTION

Antibiotic resistance occurs when the bacteria change in such a way that it reduces the effectiveness of the drug, chemicals, or other agents which are designed to prevent or cure an infection. This results in the survival of the bacteria, and it continues to multiply causing more harm. In light of this, there is a need to look for alternate options that are effective, relatively safe, and economical.^[1] Research in Phytosciences, an emerging multidisciplinary science, has revealed various medicinal plants possessing antimicrobial activity with fewer side effects and reduced toxicity. Extracts of these medicinal plants offer a new choice for optional antimicrobial therapy against various oral microorganisms.^[2] The extract of the medicinal plant is also known as essential oils. An essential oil is a concentrated hydrophobic liquid containing volatile aroma compound from the medicinal plants. The essential oils are the oil which is extracted from the plant and also called as volatile oils, ethereal oils, or aetherole. Essential oils are usually extracted by the process called distillation or using steam.

Besides these two processes, essential oils can also be extracted by absolute oil extraction, expression, solvent extraction, resin tapping, or cold pressing.^[3] One of the commonly used essential oils in the field of medicine and dentistry is extracted from lemongrass.

Lemongrass, also called by the name citronella grass, is a member of the Poaceae family and belongs to the genus *Cymbopogon*. The botanical genus name *Cymbopogon* for lemongrass is derived from Greek “cymbo” boat and “pogon” beard. It refers to the bulbous end which is boat-shaped and the long blade-like green leaves resembling a beard. Also known as “Squinant” in English, lemongrass is known by various other colloquial names throughout the world.^[4] The genus *Cymbopogon* constitutes approximately 140 species that show widespread growth across the semi-temperate and tropical regions of Asian, American, and African continents. Lemongrass is native to India, and commercially it is grown in Florida and California.^[5] There are two major species of lemongrass. The two of the major species are known as *Cymbopogon citratus* and *Cymbopogon flexuosus*. The members of the *Cymbopogon* genus produce volatile oils and thus are also known as aromatic grasses. This lemongrass is extracted from the leaves through the process of steam distillation. The process of distillation is done

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by placing the raw plant material into a distillation apparatus and placed over the water. As the water is heated, the steam passes through the raw plant material and vaporizes the volatile compound. The released vapor flows through a coil, where it is condensed back to liquid, which is eventually collected by a receiving vessel.^[6]

The volatile oil which is produced is of thin consistency and has a strong aroma which is citrusy and fresh. A strong lemon fragrance, a predominant feature of this grass, is due to the high citral content of its oil. The redolence of the oil enables its use in soaps, detergents, etc. As a good source of citral, it finds an application in the perfumery as well as food industries. It is also the starting material for the manufacture of ionone's, which produce Vitamin A.^[7]

Lemongrass contains several bioactive compounds that impart medicinal value to it and has been traditionally used to remediate a plethora of medical conditions. This is due to the broad spectrum of secondary metabolites that it produces. Lemongrass oil is rich in Vitamin C, A, and E. Its chemical components such as phenol and flavonoid substances were reported to show many *in vitro* and *in vivo* biological activities such as antioxidant, anti-inflammatory, and antimutagenic activities.^[8] Apart from these biological activities, lemongrass essential oil has a wide range of antimicrobial effects such as antiamebic, antifungal, antimycobacterial, and antibacterial against both Gram-positive and Gram-negative organisms.^[9] Due to these antimicrobial activities, lemongrass has been used as a substitute for medicational drugs which may cause a side effect on long-term consumption. Lemongrass has been reported to be used on both the medical and dental field.

Lemongrass has been used widely in the dental field as it has antimicrobial activity against Gram-positive and Gram-negative organisms. The benefits of lemongrass in dentistry includes management of halitosis, control of plaque, management of gingivitis, management of periodontitis, prevention of dental caries, and prevention of microorganism growth in the oral cavity.^[10] Besides dental field, lemongrass is also used as an alternative to drugs to treat medical conditions such as sinusitis, bladder infections, respiratory infections, digestive problems, and also for regeneration of connective tissue. Lemongrass extract is also used for the treatment of rheumatoid arthritis and liver disease in countries like China.^[11]

Hence, the objective of this article is to highlight various uses and benefits of lemongrass oil in oral health.

VARIOUS USES OF LEMONGRASS IN DENTAL HEALTH

1. Management of halitosis (Bad breath)
2. Plaque control
3. Management of gingivitis
4. Management of periodontitis
5. Prevention of dental caries
6. Antifungal activity.

Management of Halitosis (Bad Breath)

Halitosis can be caused by several factors such as food debris, plaque accumulation, tongue coating, gingivitis, and periodontitis.^[12] The unpleasant smell of the breath mainly originates from the volatile sulfur compounds especially hydrogen sulfide, methyl mercaptan, and less importantly dimethyl sulfide as discovered by Tonzetich.^[13] However, cases such as xerostomia other compounds in the mouth air may also cause halitosis such as diamines, indole, skatole, and volatile organic acids (butyric or propionic acid). These compounds are actually a result of proteolytic degradation by an oral microorganism of peptides present in saliva. In particular, proteolytic degradation is carried out by Gram-negative anaerobic bacteria.^[14] Since lemongrass contains high citral content, it has been used as a mouthwash to control the bad odor from the oral cavity. Besides that, since lemongrass has an antimicrobial action against Gram-negative bacteria, the proteolytic degradation by the bacteria can be reduced which results in the control of the bad breath.^[15]

Management of Dental Plaque

Dental plaque is predominately composed by Gram-positive cocci at the tooth surface and Gram-negative rods in the outer surface of the plaque matrix.^[16] Removal of dental plaque on a daily routine is one of the major factors in the prevention of caries, gingivitis, and periodontitis. Since both gingivitis and periodontitis are plaque associated oral conditions, the removal of dental plaque should inhibit their occurrence and progression of the disease. Disclosing agents make the plaque visible and are available in tablet, lozenges or wafers, which contain a dye or other coloring agents.^[17] Plaque control can be obtained through the mechanical removal of the biofilm by proper use of tooth brushing technique and flossing. Chemical control of plaque is considered to be adjunct to mechanical oral hygiene practices; the agents are most commonly used in the form of mouthrinse to prevent and control the plaque formation. The interaction between saliva-coated tooth surfaces and pathogenic bacteria is partly governed by electrostatic and hydrophobic interactions, providing a solid rationale for using chemical agents as part of a plaque-control routine.^[18]

Chlorhexidine digluconate is the most effective antiplaque and antigingivitis agent which is used as an adjunct to maintain oral hygiene.^[19] However, several side effects are also associated with its use such as staining of teeth and restorations, unpalatable taste with taste alteration have stimulated the search for new alternatives. Essential oils such as lemongrass are ideal for use in oral care products because they are both antibacterial and non-toxic which is a rare combination. Lemongrass oil can be used as an adjunct to mouthwash to prevent plaque formation and also to remove the plaque. Lemongrass is effective in busting through the tough biofilm that *Candida* hides behind and hence it can be used as a mouthwash and toothpaste to remove biofilm, which ultimately forms plaque.^[20] Lemongrass inhibits the growth of several kinds of microorganisms at a concentration $\leq 2\%$. Lemongrass oil is the most effective in removing plaque as compared to a slurry toothpaste and chlorhexidine mouthwash. The terpenes present in lemongrass oil alter cell permeability by penetrating between the membrane lipid bilayers, disrupting lipid packing, and changing membrane fluidity leading to major surface alterations and morphological modifications thereby reducing the adherence capacity of oral pathogens.^[21] The anti-biofilm activity of lemongrass is exhibited due to the presence of various constituents such as citral, limonene, citronellal, B-myrcene, linalool, and geraniol. Hence, it can be concluded that lemongrass oil mouthwash can be used as an adjunct to mechanical and other chemical plaque control without any side effects.^[22]

Management of Gingivitis

Gingivitis is inflammation of the gums due to the accumulation of plaque, by means of a naturally occurring process, resulting from bacterial interactions with the acquired salivary pellicle formed over the surface of the tooth shortly after brushing the tooth. Gingivitis may develop into periodontitis in vulnerable subjects; therefore, by preventing gingivitis, periodontitis can be prevented successfully.^[17] Effectiveness of mechanical methods depend on skills and technique of the individual and have proved to be very time-consuming, this necessitates the use of chemical control of plaque as an adjunct to mechanical plaque control regimen.^[23,24] Essential oil mouthwash prevents bacterial aggregation, slows their multiplication and extracts the bacterial endotoxins.^[25]

In gingivitis, the inflammatory infiltration mainly consists of lymphocytes, plasma cells, and neutrophils, which affects the oxidative stress and antioxidant pattern of these tissues.^[26] To overcome this oxidative stress and maintain homeostasis, these tissues depend on natural antioxidants which is very well provided by the lemongrass oil. Microbial recolonization of periodontal pockets can be prevented by the

effective anti-inflammatory and antimicrobial activity of lemongrass oil which augmented the clinical resolution of gingival inflammation. Furthermore, periodontal tissue destruction is prevented, and healing is enhanced by the antioxidant activity of the same.^[27]

One of the non-enzymatic antioxidants found in every cell of the body is glutathione (GSH), also known as sulfhydryl GSH plays an important role in protection against oxidative stress. A study by Susanto *et al.* stated that gargling with 2% and 4% concentrations of lemongrass essential oil increased the salivary GSH levels in moderate gingivitis patients, with the same potency as hexetidine 0.1% so that it can speed-up gingivitis healing process.^[9] Antioxidants like that of lemongrass essential oil overcome the ill-effects caused due to reactive oxygen species activity. In an inflammatory process like gingivitis, GSH not only acts as an antioxidant but also an immune function modulator. It directly acts as a free radical scavenger in detoxification of reactive oxygen and nitrogen species and also avoids the production of pro-inflammatory cytokines.^[28]

The antioxidant property of lemongrass oil was evaluated in a study done by Anand *et al.* The salivary and gingival crevicular fluid, superoxide dismutase and thiol levels were estimated before and after its administration of lemongrass oil, their result eventually shows that superoxide dismutase and thiol levels increased along with a reduction in gingivitis. From the quoted results, it can be implied that the lemongrass oil mouthwash may have an adjunctive effect on the treatment outcome when it is used along with non-surgical periodontal therapy.^[22,29]

Management of Periodontitis

It has been long recognized that periodontal diseases, i.e., the infections of the periodontium comprise the bacterial etiology, an immune response, and tissue destruction.^[30] Periodontitis is an inflammatory condition caused due to oxidative stress along with microbial toxins. It is characterized by inflamed tissue with or without bleeding around the teeth, and there will be loosening of the collagen fibers around the teeth leading to super infections followed by the mobility of the teeth.

Failure of mechanical instrumentation to eliminate the penetrating bacteria completely from the sulcus and the surrounding tissue, and at the same time, the role of certain specific bacteria in the etiology or progression of periodontal disease has directed the use of antimicrobial agents in periodontal therapy.^[31] The predominant microorganisms associated with periodontitis are mainly anaerobic and facultative anaerobic bacteria such as *Porphyromonas*

gingivalis, *Prevotella intermedia*, *Aggregatibacter actinomycetemcomitans* (former name *actinobacillus actinomycetemcomitans*), and *Tannerella forsythia* (former name *Bacteroides forsythus*). Various antimicrobial drugs (e.g., tetracycline, minocycline, clindamycin, metronidazole, and chlorhexidine) have also been used as adjuncts to mechanical treatment.^[32] Treatment strategies aiming primarily at suppressing or eliminating specific periodontal pathogens include adjunctive use of local and systemic antibiotics as a part of nonsurgical periodontal therapy.

Over a period of time, the unwanted side effects and resistance of microorganisms to antibiotics has to lead the need to look for alternate options that are effective, relatively safe, and economical. Hence, the introduction of lemongrass was done in preventing and treating periodontitis due to the antioxidant properties. Lemongrass prevents periodontitis by increasing the level of thiol antioxidants and also by reducing the bacterial load.

Lemongrass oil shows antioxidant activity due to its contents such as citral (neral and geranial) and citronellal. Citral contains stereoisomers called neral and geranial which is able to subside oxidative stress through GSH's antioxidant system induction.^[33] It can also act through terminating the chain reaction of lipid metabolism by donating hydrogen to free radical. Flavonoid a chemical component of lemongrass oil has many biological activities, namely antioxidant, anti-inflammatory, antimicrobial, antimutagenic, and antitumor. Hence, its activity can evade the oxidation reaction along with reducing hydroxyl radical, peroxy radical, and superoxide. Citral is not only an active component of lemongrass oil but also helps in the formation of Vitamin A and C; which are secondary antioxidants to scavenge free radicals and also prevents damage by stopping the chain reaction.^[34]

An *in vitro* study was done Khongkhunthian *et al.* to investigate the antimicrobial activities of the essential oil from *Cymbopogon citratus* (DC.) Stapf. (lemongrass) against some periodontal pathogens, including *Actinomyces naeslundii* (WVU 45), *P. gingivalis* (WP 50), and the clinical isolates from three gingivitis and three periodontitis patients, using the broth dilution and antibiotic-sensitivity tests. The result shows that lemongrass oil shows good antimicrobial activity.^[35] Besides that, according to a study done by Warad *et al.*, it showed that 2% lemongrass essential oil can be used as a local drug delivery agent for the treatment of periodontitis. 2% lemongrass essential oil gel appears to be an attractive alternating agent that can be used for effective and safe local drug delivery as an adjunct to mechanical nonsurgical periodontal therapy.^[36]

Management of Dental Caries

It is an infectious microbiologic disease of the teeth that results in localized dissolution and destruction of the calcified tissues. Dental caries can be due to four factors: Host, microflora, substrate, and time.^[37] The likelihood of dental caries development is higher when the microbial load is high due to excessive plaque. The bacteria can survive in acidic conditions. The oral cavity has many types of bacteria, but only a few bacteria participate in dental caries formation.

Streptococcus mutans, a facultative Gram-positive anaerobe is commonly found in the oral cavity. It is the primary causative agent of dental caries. *S. mutans* can strongly adhere to the tooth surface and easily colonize the tooth by initiating acid production through the formation of extracellular polysaccharides from sucrose food.^[9] Management of dental caries focuses on limiting tooth demineralization by altering the dietary habits, preventing or modifying oral microbial growth, altering the salivary pH and buffering capacity.

Essential oils inhibit microorganisms due to their hydrophobicity, in which they get partitioned into the lipid bilayer of the cell membrane, rendering it more permeable, leading to leakage of vital cell contents. Impairment of bacterial enzyme systems may also be a potential mechanism of action.^[38]

According to a study done by Khirtika, the antimicrobial activity as an anticaries agent was compared between 0.2% chlorhexidine, 2% iodine, and homemade mouthrinse (lemongrass oil mouthwash). The result obtained in the study shows that the antimicrobial efficiency was highest for essential oils followed by chlorhexidine and iodine. The aqueous extract of essential oils strongly inhibits the growth of *S. mutans*.^[39] Where else, in a different study done by Banu and Geetha, the antimicrobial efficacy of lemongrass oil and thyme oil on *S. mutans* was evaluated. The results show a similar finding as for the previous study. Both the essential oils have got a very good antibacterial activity against *S. mutans*.^[40] Hence, the elimination of cariogenic bacteria from the oral cavity for the prevention of dental caries can be done using essential oils as they have good antimicrobial action with no side effects.

Anti-candida Activity

Oral candidiasis is also known as oral thrush. It is a fungal infection (mycosis) caused by any of the *Candida* species, of which *Candida albicans* is the most common. Since lemongrass has an antifungal activity against *C. albicans*; it is used to manage health problems related to *C. albicans*. The essential oil of lemongrass 1000 ppm inhibited fungal growth

completely.^[41] Hence, lemongrass oil can be used in the treatment of oral candidiasis. Their mechanism of action appears to be predominantly on the fungal cell membrane, disrupting its structure causing leakage and cell death; blocking the membrane synthesis; inhibition of the spore germination, fungal proliferation, and cellular respiration. Due to the high volatility and lipophilicity of the essential oils, they are readily attached to penetrate the cell membrane to exert their biological effect.^[42] Lemon grass essential oil is highly effective in the vapor phase against *C. albicans*, leading to deleterious morphological changes in cellular structures and cell surface alterations.^[43]

CONCLUSION

Lemongrass has been shown to possess antibacterial, antifungal, antiviral insecticidal, and antioxidant properties. Their usage has been very beneficial to both the dental and medical fields. In dental field, lemongrass is found to be used in the management of dental plaque, gingivitis, periodontitis, halitosis, and also in oral candidiasis. Hence, based on this review it can be concluded that lemongrass oil can be used as an adjuvant to chemical drugs in treating various problems and diseases of oral health.

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