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# Plants Extract Oils and Their Antimicrobial Activity in Treatment of Denture Stomatitis: Lemongrass Essential Oil (A review of literature)

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## ABSTRACT

Microorganism buildup is one of the most critical issues with soft denture liner materials resulting in a disease known as denture-induced stomatitis, caused by a fungus, namely Candida albicans (*C. albicans*). As a result, creating a soft lining material with a medication delivery system is required.

In this review of literature, the light will be concentrated on the role of oil extracted from natural herbs in the treatment of denture stomatitis with a focus on lemongrass essential oil in this review.

## Keywords

Denture stomatitis, Essential oils, and Lemongrass essential oil, Antimicrobial activity of natural herbs, Essential oils in dentistry.

## INTRODUCTION

Denture-induced stomatitis is an inflammatory disorder that affects the mucosa beneath removable dentures, whether they are complete or partial. Denture stomatitis is most common in total denture wearers, with the maxillary arch being the most commonly affected site. Patients with a cleft palate who wear an obturator as well as those wearing orthodontic appliances are frequently affected. Males and females are both susceptible to denture stomatitis, with the latter having a higher prevalence (Petrovic, 2014) (Issa, 2019).

Candidal adhesion to the inner surface of the acrylic denture base is the most important phase in denture-induced stomatitis (Yasser, 2017) (Le Bars, 2022) (Vila-Nova, 2022)

Antifungal medicines used to treat denture-induced stomatitis might have substantial adverse effects such as resistance, sensitivity, or recurrence (Mawlood, 2020). Bakhshi and Petrovi et al. (2014) have proposed a new therapy line in which natural herbal compounds are used as alternatives to chemical substances to reduce unwanted side effects in people (Petrovic, 2014) (Bakhshi, 2012). For decades, several plant products have been used. However, proper clinical trials are required to compare their efficacy to that of currently available chemical medications. To be biologically active, some plant extracts require particular processing or conditions (Bakhshi, 2012). As a result, a new therapeutic approach is required, and the role of natural medicines is critical, as some of these products might be included in the formulation of mouthwashes or tooth pastes (Marcos-Arais, 2011).

Garlic was one of the first plants utilized to extract natural medicine products, and it has the unique capabilities of providing immune system support as well as possessing antibacterial properties. In the treatment of denture stomatitis, aqueous garlic extract has been authorized as an effective substitute for nystatin mouth rinse (Bakhshi, 2012).

Chitosan is a biocompatible polymer derived from plants that has antifungal and antibacterial properties, allowing it to be used in a variety of medical fields. Chitosan oligomers interfere with the growth enzymes of *Candida albicans* (*C. albicans)* and it is recommended to be placed on the oral mucosa. Furthermore, a study found that chitosan solution is equivalent to nystatin in the treatment of denture stomatitis (Atai, 2017) (Chandrasekaran, 2020) (Mohammed, 2020).

Oils are one of the natural herbal-based medicines. They have been hailed as a possible treatment option for oral microbial infections. Oils are a complex mixture of diverse volatile chemicals obtained from herbs that, thanks to their antibacterial and antioxidant capabilities, can defeat a wide range of harmful organisms (Petrovic, 2014).

Various oils have been evaluated for antifungal activity against *C. albicans* in denture wearers suffering from denture-induced stomatitis throughout the last few decades (Perchyonok, 2017).

Menthone, menthol, eugenol, linalool, tyrosol, carvacrol, and farnesol are examples of nature-derived oils that have powerful antifungal properties. Furthermore, carvacrol oil has a particularly strong antifungal impact, especially against *C. albicans* strains that are resistant to the fluconazole treatment (Marcos-Arais, 2011).

Satureja hortensis extract found to be a broad range antibacterial agent that affects not only fungi but also yeast and bacteria. Pelargonium graveolens and Satureja hortensis are two plant species whose extracted oils are used to treat Candida-related denture stomatitis. One percent of a gel made from these oils extracts has been approved to minimize fungal development and erythematous lesions in the oral cavity (Petrovic, 2014).

Tea tree oil is also well-known for its antifungal properties; a study found that it aids in the eradication of fluconazole-resistant candida in AIDs patients. Additionally, 0.25 percent of this oil inhibits candida's multiplication by creating germ tubes. Tea tree oil can be used to soft liners and tissue conditioner to help with denture-induced stomatitis suggesting a new oral candidiasis management method (Pachava, 2015).

of organically derived medicaments that have been put into soft liner materials or tissue conditioners (800 μL) and have shown to have potent anti-C. albicans efficacy (Muttagi, 2017). Although all of the oils indicated above work against *C. albicans*, each one has a unique active ingredient that affects fungi in a different way. So it's no surprise that there are differences in the antifungal and antibacterial properties of herbal extracts; this is due to differences in the plants themselves and their extract compositions, differences in the method of extraction and processing, differences in the genetic composition of fungi and bacteria, and whether the last two are from the same or different species (Petrovic, 2014).

## LEMONGRASS ESSENTIAL OIL (LGEO)

Lemongrass (LG), also known as Cymbopogon, is one of roughly 55 grass species belonging to the Poaceae family. Cymbopogon citratus and Cymbopogon flexuosus are the two most popular kinds among these many. Though they can both be used to make essential oils, the former is more commonly used in cooking, and the latter is more commonly utilized in essential oils and perfumes. LG is a herb with fibrous stalks that smell like lemons. LGEO has a light and fresh aroma with a hint of lemon (New Directions Aromatics, 2017)

## CHEMICAL COMPOSITION

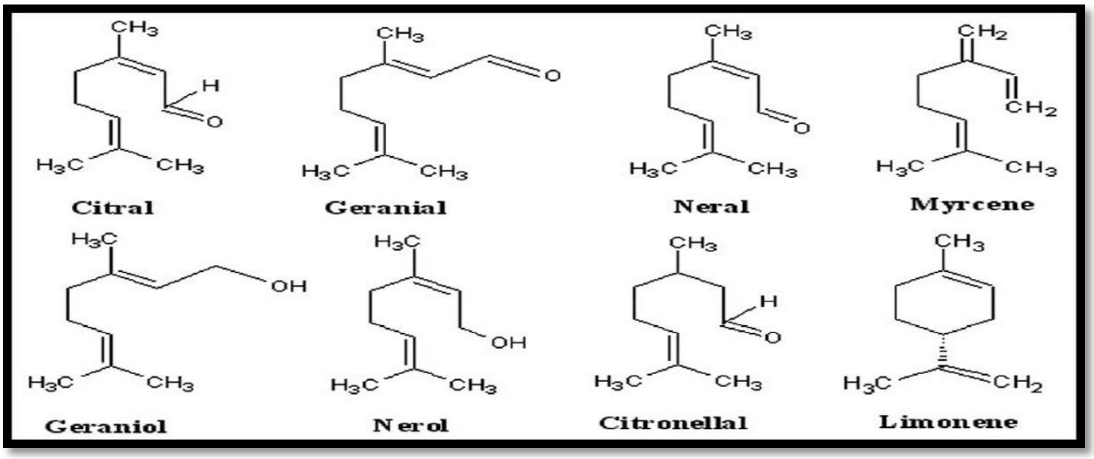
The main chemical constituents of LGEO are: Myrcene, Citral, Citronellal, Geranyl Acetate, Nerol, Geraniol, and Limonene (Shah, 2011).

Each one of the ingredients have some benefits which can be illustrated in the Table 1:

(Table 1): Chemical composition of lemongrass essential oil and their benefits (Shah, 2011).

| | |
|---|---|
| Myrcene | Anti-inflammatory, Analgesic, Anti-biotic, mutagenic, Sedative |
| Citral | Anti-viral, Anti-septic, Anti-oxidant |
| Citronellal | Anti-fungal, Sedative, Anti-viral, Anti-microbial |
| Geranyl Acetate | Anti-fungal, Anti-microbial, Anti-inflammatory |
| Nerol | Anti-oxidant, Sedative, Anti-inflammatory, Anti-depressant |
| Geraniol | Anti-oxidant, Anti-bacterial, Anti-septic, Analgesic |
| Neral | Apoptotic, Anti-nociceptive, Anti-inflammatory |
| Limonene | Anti-oxidant, Digestive, Appetite suppressant, Detoxicant |

While the chemical structure of LGEO can be seen in the Figure (1) below:




(Figure 1): Structure of lemongrass essential oil (Shah, 2011).

## EXTRACTION METHODS USED FOR LEMONGRASS ESSENTIAL OIL

To execute the extraction process, a variety of extraction techniques have been studied. The traditional and oldest method of extraction is solvent extraction and hydrodistillation. When adopting these strategies, however, there are some limitations. Hexane, a hazardous solvent, was utilized in Soxhlet extraction. This approach also necessitated an extra step to remove the solvent from the extract (Zambree, 2020) (Schaneberg, 2002).

In hyrodistillation, a larger amount of water was employed at a higher temperature. Increased temperature causes volatile molecule losses and chemical changes of oil components. Not only that, but the same causes a partial or complete breakdown of natural elements. The extraction procedure took a considerable time in each of these methods. To replace the traditional methods of extraction, a new technique called supercritical fluid extraction (SCFE) was devised. This process is more environmentally friendly and ideal for products made from natural ingredients (Zambree, 2020) (Ranitha, 2014).

The supercritical method (SC) is considered a modern method of extraction, because of the use of a supercritical form of $CO_2$ which is environment friendly, cheap, odorless, non-toxic, non-flammable, easy to remove from the product, and easily available. $CO_2$ is recognized as safe by the food and drug administration (FDA) (Marongiu, 2006). $CO_2$ in the mobile phase allows the extraction of thermally-liable/easily oxidizing compounds even at low temperatures and under a non-oxidant medium. SC ($CO_2$) possesses physiochemical properties that are intermediate between those of liquids and gases, these fluids can diffuse through solid raw material like a gas and dissolve biochemical extracts present inside the plant matrix like a liquid (Silva, 2011).

Small changes in pressure and temperature close to the critical point result in greater changes in density allowing many properties of supercritical fluid (SCF) to be finely tuned, thus SCFE can preferably substitute organic solvents for extraction purposes (Muttalib,2018) (Falcao, 2012).

The driving force for any extraction process is the solubility of the target compound in the selected solvent, which depends on the interactions between the solvent and solute. Supercritical fluid extraction (SCFE) has emerged as a superior alternative technique for the extraction of bioactive species from natural produces. SCFE is based on the solvating properties of supercritical fluid (SCF), which can be obtained by employing pressure and temperature above the critical point of a compound, mixture, or element. The SFE setup comprises an extraction vessel, accumulator, and separator (Moncada and Tamayo, 2014).

The system is charged with liquid $CO_2$ mixed with lemongrass (Cymbopogon Citratus) material and is injected into the extraction vessel through a syringe pump having a pressure rating of at least 400 standard atmospheres (ATM). The liquid is pumped to the heating zone where it is heated to supercritical conditions at elevated pressure. The fluid then is passed through the extraction vessel where it rapidly diffuses through the solid lemongrass matrix and dissolves the material to be extracted. The dissolved material is swept from the extraction cell into the separator at a lower pressure so that there is high relative volatility between lemongrass oil and $CO_2$ which will turn $CO_2$ into vapor making a vapor-liquid equilibrium. The extracted material settles out and the SC $CO_2$ can then be cooled, discharged into the atmosphere, or recirculated through the closed-loop system (Paviani, 2006).

## USES OF LEMONGRASS ESSENTIAL OIL

LGEO has a wide range of applications, from medical to aromatic to cosmetic. Oils, gels, lotions, soaps, shampoos, sprays, and candle manufacturing are just a few of the numerous shapes it takes (Wagh, 2021).

LGEO when diluted with a carrier oil and used topically, improves muscle aches and pains, as well as headaches and arthritis-related discomforts. Its anti-inflammatory effects alleviate redness, irritation, and swelling while toning and purifying the skin. LGEO is a wonderful addition to cosmetics that are designed to assist produce luminous and uniformly toned skin because of its antibacterial and astirngent properties. It cleans pores and strengthens skin tissues as a toner. LGEO may be used to strengthen hair, stimulate growth, and ease itchiness and irritation on the scalp and skin by incorporating it into shampoos and body washes and rubbing it into the scalp and body (Majewska, 2019).

LG is a natural perfume and non-toxic air freshener used in aromatherapy to create a calm ambiance and eliminate undesirable odors. Its carminative qualities provide assistance to the digestive system when diffused. It may be used to make natural scented cosmetics and soaps at home. It is known to help with anxiety, stress, irritability, lethargy, nervousness, and sleeplessness, as well as fork improving negative moods and preventing depression. LGEO when used as a cream or lotion, can help to minimize the appearance of cellulite and treat fungal infections as well as acne (Wagh, 2021).

LG is a tropical plant that is native to Africa, Asia, Southeast Asia, Australia, and Oceania, where it has been utilized for medicinal, cosmetic, and culinary uses for centuries. It has been utilized as a flavoring agent in beverages, sweets, and other culinary preparations in nations such as India, China, and Thailand for its capacity to promote better digestion, increase circulation and immunity, treat infections, and relieve irregularities in menstrual cycles. LG is known as "fever grass" in various cultures because of its ability to decrease fever (Abed, 2022).

LG was traditionally used to produce soups, curries, and a native beverage known as "fever tea," which was believed to treat not only fevers but also diarrhea, irregular menstruation, stomach problems, and skin infections in East India and Sri Lanka. It was used in China for similar purposes. It is still used to treat high blood pressure and aid digestion in Cuba and the Caribbean today. News of the LG plant and its therapeutic essential oils is thought to have traveled swiftly in 1905, when a Sri Lankan researcher named Jovit purchased several "Kochin Sera" plants (Cymbopogon citrates) from South India and put them on a farm to undertake research (New Directions Aromatics, 2017).

Kurniasih et al. in 2015 found that LG have a larvicidal effect which is concentration-dependent for the Aedes aegypti larvae. Based on research results essential oil can kill mosquito larvae, so they can be used as a green pesticide candidate (Kurniasih, 2015).

LGEO is used for the treatment of periodontal disease, Warad in 2013 and Ilango et al., in 2019 found that it reduces pocket depth (Warad, 2013) (Ilango, 2019).

**TOXICITY AND LIMITATION OF LEMONGRASS ESSENTIAL OIL**

The essential oil (EO) from Cymbopogon citratus is reported to have a wide range of biological activities and is widely used in traditional medicine as an infusion or decoction. However, despite this widely use, there are few controlled studies confirming its biological activity in central nervous system (De Almeida Costa, 2011).

Consumers (especially pregnant women) should be informed about their concentration levels and their possible adverse effects are taken into account when they are consumed over toxic limit (Türkmenoğlu, 2021) (Uwamose, 2017).

LGEO should not be consumed during pregnancy as the two compounds found in lemongrass, namely, citral and mycrene can have adverse effects on pregnancy. Mycrene, when consumed in high doses, can hamper the skeletal development of the fetus and even result in a miscarriage. Consuming LGEO during pregnancy may have harmful effects but its effects have not been empirically studied on humans. The advice to avoid lemongrass in high doses is based on logical conjectures and also on studies conducted on rats. LGEO has long been used in herbal medicine to bring on menstruation. In large quantities, it could induce the rupture of the foetal membrane, causing a miscarriage (Wifek, 2016)

LGEO affects blood sugar regulation. If the woman has type 2 diabetes or gestational diabetes, and she takes too much lemongrass, it could lead to a sudden decrease in her blood sugar levels, which can cause tiredness, blurry vision and even dizziness. Intake of LGEO in concentrated forms such as lemongrass tea or supplements can lead to severe complications during pregnancy. Lemongrass can be consumed in small amounts, such as in Thai dishes, where it is used as a seasoning, but it is best avoided altogether (Manvitha, 2014) (Adeneye, 2007).

LGEO may irritate the skin and cause a rash. To minimize the risk of skin irritation, a person should avoid applying LGEO to the skin if: (Ekpenyong, 2016)

1.They have allergies or skin conditions, such as eczema.

2.They have not diluted the oil first.

3.They have broken or damaged skin.

A skin patch test on a small area of skin should be done to check for any allergic reaction, then waiting 24 hours to see if a reaction appears before applying the diluted oil more liberally. LGEO can also cause dryness and stinging around the eyes, ears, mouth, and other mucous membranes, such as the genital area. For this reason, it is best not to use it on the face or put the oil into bathwater (Ali, 2017) (Abd-El Fattah, 2010).

## CONCLUSION

Lemongrass essential oil is a potent antimicrobial herb extract that can be used in the treatment of denture stomatitis.

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# الزيوت المستخلصة من النباتات ونشاطها المضاد للميكروبات في علاج التهاب الفم المصاحب للتبطين المرن للتركيبات المتحركة: الزيت الأساسي المستخلص من عشبة الليمونية

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**المستخلص:**

نظرًا لخاصية المرونة التي تتمتع بها مادة التبطين، فإن هذه المواد ستعمل على خفض وإعادة توزيع قوى الإطباق على منطقة تحمل طقم الأسنان. واحدة من اهم المشاكل الرئيسية المرتبطة باستخدام البطانة المرنة هي زيادة خطر استعمارها بواسطة كائنات دقيقة هي المبيضات البيضاء مسببة التهاب الفم، لهذا السبب أصبح من الضروري جدا تطوير مادة التبطين المرنة وذلك عن طريق إضافة مواد لها القابلية على تثبيط عمل هذه المبيضات وتقليل الالتهاب الناتج عنها لتعمل بصورة جهاز امداد دوائي مستمر ومن اهم هذه الإضافات هي الزيوت المستخلصة من الاعشاب. ففي هذا البحث سيتم تركيز الضوء على دور عدة أنواع من الزيوت المستخرجة من الأعشاب الطبيعية في علاج التهاب الفم المصاحب بوجود البكتريا والفطريات التي تستوطن بطانة الفم المرنة المبطنة للتركيبات المتحركة المستخدمة في طب الاسنان مع التركيز على زيت عشبة الليمونية الأساسي بصورة رئيسية.

الاستنتاج :يمكن اعتبار زيت عشبة الليمونية مادة قوية مضادة للفطريات ودمج زيت عشبة الليمونية في البطانة الناعمة يمكن أن ينتج بنجاح مادة بطانة ناعمة مع نشاط مضاد للفطريات.

**الكلمات المفتاحية**: التهاب الفم المصاحب للتركيبات المتحركة، الزيوت الأساسية، الزيت الاساسي لعشبة الليمونية النشاط المضاد للميكروبات للأعشاب الطبيعية، الزيوت الأساسية في طب الأسنان.