



A REVIEW: PLANT OVERVIEW, PHYTOCHEMICAL ASPECTS, AND PHARMACOLOGICAL ACTIONS OF *Cymbopogon citratus* (LEMONGRASS)

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ABSTRACT

The Lemongrass (*Cymbopogon genus*), encompassing various herbs renowned for their abundant essential oil content, has been extensively utilized worldwide for both commercial and medicinal purposes. Among these, Lemongrass oil, derived from *Cymbopogon citratus*, stands out for its ethno-botanical significance and therapeutic potential. Rich in properties such as antibacterial, antifungal, anti-inflammatory, and antioxidant effects, lemongrass oil has garnered attention for its multifaceted benefits. With mosquitoes being vectors for debilitating and deadly diseases like malaria and dengue fever, the need for effective repellents is paramount. While synthetic compounds like DEET dominate the market, lemongrass has emerged as a traditional alternative due to its historical use as a mosquito repellent. Originating from regions in Asia and Australia, Lemongrass is cultivated globally, thriving in warm, tropical climates. Its cultivation requires specific conditions including suitable soil pH and ample sunlight. The plant's morphology, characterized by linear leaves and a citrusy fragrance, contributes to its distinct appearance and aroma. Lemongrass essential oil, extracted through steam distillation, boasts a complex composition of phytochemicals such as citral, geraniol, limonene, and linalool, each contributing to its therapeutic properties. The studies have explored Lemongrass's pharmacological actions, revealing its potential in combating inflammation, filarial infections, diarrhea, and microbial diseases. Its aroma also finds application in relieving respiratory issues and headaches. Despite promising findings, further research is necessary to elucidate its mechanisms of action and establish recommended dosages. In conclusion, Lemongrass emerges as a versatile botanical with significant implications for public health, particularly in mosquito control and disease prevention. Its rich chemical composition, coupled with its historical significance and pharmacological actions, positions it as a valuable asset in both traditional and contemporary medicine. However, caution is advised, especially regarding dosage and safety considerations, underscoring the importance of consulting healthcare professionals before its medicinal use.

Keywords: Lemongrass, *Cymbopogon citratus*, essential oil, phytochemicals, pharmacological actions, mosquito repellent, traditional medicine, public health.

1. INTRODUCTION

The *Cymbopogon* genus, belonging to the Gramineae family (also referred to as Poaceae), comprises herbs well-known for their abundant essential oil content. These plants are found globally, spanning across all over the world, and have been utilized for various purposes. The diverse species within the *Cymbopogon* genus have well-documented commercial and medicinal uses[3]. Lemongrass oil, derived from the aerial parts of *Cymbopogon citratus*, has a rich history of ethnobotanical and medicinal uses. Various properties of lemongrass oil and its extracts have been explored and documented, making it a versatile substance with applications in different fields. This suggests that the oil may be effective in repelling or controlling insects. Studies, such as those by Syed et al. have highlighted the antimicrobial properties of lemongrass oil. This property could make it useful in preventing the growth of microorganisms[1]. Lemongrass oil and its extracts have indeed been recognized for their therapeutic properties. These properties include antibacterial, antifungal, anti-inflammatory, and antioxidant effects, among others. "*Cymbopogon citratus*" is known for their multifaceted benefits, these extracts boast an impressive array of medicinal properties, ranging from potent antibacterial and antifungal attributes to profound anti-inflammatory and antioxidant effects[21]. Essential oil obtained from lemongrass is extracted meticulously through the delicate process of steam distillation from the verdant leaves of the lemongrass plant (*Cymbopogon citratus*). Mosquitoes have been involved in spreading of highly incapacitating and fatal illnesses to humans, including malaria, filariasis, dengue fever, and yellow fever.[2]. Modern mosquito repellents commonly contain DEET (N,N-diethyl-3-methylbenzamide). DEET is effective as a repellent surpasses that of alternative products, making it the preferred compound in insecticides[2]. It's crucial to recognize that the safety of an insecticide is determined not solely by its active ingredient but also by its formulation, concentration, and correct applications. Regulatory bodies, like the Environmental Protection Agency (EPA) in the United States, oversee these aspects.[2]. Lemongrass has been used traditionally as an important mosquito repellent.

1.1 ORIGIN AND DISTRIBUTION

Lemongrass, scientifically known as *Cymbopogon citratus*, is indeed native to regions in Asia, particularly Southeast Asia, and Australia. It has been widely cultivated in tropical and subtropical regions around the world due to its culinary and medicinal uses[5]. It is cultivated all over the world because of its culinary use also. In India, lemongrass is distributed in the regions of Kerala, Karnataka, Tamil Nadu, Assam and some regions of Uttar Pradesh[27].

1.2 SPECIES OF LEMONGRASS

"*Cymbopogon flexuosus*", commonly referred to as East Indian Lemongrass, is a member of the Graminae (Poaceae) family and the genus *Cymbopogon*. It typically reaches a height of approximately 2 meters and features linear and lanceolate leaves. Its inflorescence is characterized by a large, highly branched terminal drooping panicle, and the plant freely produces flowers with paired spikes on tertiary branches. These spikelets consist of paired spikes with one sessile (awned bisexual floret) and one pedicellate (awnless staminate floret).

On the other hand, *Cymbopogon citratus*, or West Indian Lemongrass, also comes under the family "Graminae" which is also called as "Poaceae" family and the genus *Cymbopogon*. It is commonly referred to as Lemongrass or Citronella Grass. This species typically ranges from 1 to 2 meters in height and features long, slender, green leaves. It is notable for its citrusy fragrance[4].

1.3 MORPHOLOGY OF LEMONGRASS



Fig 1: Lemongrass plant

Cymbopogon citratus, commonly known as lemongrass. Lemongrass is indeed an evergreen, perennial grass known for its aromatic properties, particularly its lemon-like scent[6]. The leaf is differentiated into blade, sheath, and adaxial ligule at the leaf sheath junction. The blade is simple, green, rough, and measures about 30e76 cm in length and 0.9e1.5 cm in width. The leaf is linear in shape and having acuminate apex. The leaf shows parallel venation[21].

1.4 CULTIVATION OF LEMONGRASS

The following conditions are required for cultivation of lemongrass:

- **Climate and Soil:** Lemongrass thrives in warm, tropical climates but can also grow in subtropical regions. Soil having pH between 6.0 and 7.5 is most suitable for the cultivation of lemongrass.
- **Propagation:** Lemongrass is commonly propagated from divisions of mature plants. Obtain lemongrass stalks from a grocery store or nursery. Cut the stalks into pieces, ensuring each division has several roots and a portion of the bulbous base. Plant these divisions directly into the soil or in pots filled with well-draining potting mix.
- **Planting:** Choose a location with full sun exposure for planting lemongrass. Space the divisions about 2 to 3 feet apart to accommodate their spread. For container planting, opt for pots that are at least 12 inches in diameter.
- **Watering:** Lemongrass requires regular watering, particularly during hot and dry periods. Maintain soil moisture consistently, but avoid waterlogging. Allow the soil to dry slightly between watering sessions.
- **Fertilizing:** Apply a balanced fertilizer or compost to the soil around the plants once or twice during the growing season to support healthy growth.
- **Pruning:** Regularly trim off dead or yellowing leaves to encourage new growth. Harvest stems for culinary or medicinal use by cutting them close to the plant's base.
- **Harvesting:** Lemongrass can be harvested when the stalks reach about 12 to 18 inches tall and feel firm to the touch. Use sharp scissors or a knife to cut the stalks at the base, leaving at least 4 inches of the stalk intact for regrowth[28].

2. PHYTOCHEMICAL ASPECTS

The therapeutic actions of the lemongrass is due to presence of various phytochemicals or secondary metabolites in lemongrass .The major phytochemicals or secondary metabolites found in lemongrass(*Cymbopogon citratus*) are Phytosteroids which are similar to cholesterol,Anthocyanins which are also called as"Anthocyan",Aminoacids,Organic acids,Fattyacids,Phenolic compounds and certain Volatile compounds. The essential oil extracted from lemongrass is rich in Citral, Geraniol, Limonene, Citronellal, Myrcene and Linalool.

- **Citral:** Citral is responsible for the citrusy aroma in lemongrass.Citral plays a significant role in shaping the flavor of the plant[21].
- **Geraniol:**Geraniol, an aromatic compound present in lemongrass, exhibits antioxidant and anti-inflammatory characteristics. Research has investigated its potential as an anticancer agent.
- **Limonene:**Limonene is a terpene which is found in the essential oil obtained from lemongrass having antioxidant properties. It is also found in various citrus fruits.
- **Citronellal:**Citronellal, found in lemongrass essential oil, exhibits insect-repelling qualities alongside antifungal and antimicrobial actions.
- **Myrcene:**Myrcene is a naturally occurring compound known as a terpene, which is found in various plants including lemongrass, hops, and mangoes. It possesses notable anti-inflammatory and analgesic properties, meaning it can help reduce inflammation and alleviate pain when consumed or applied.
- **Linalool:**Linalool, an alcohol terpene present in lemongrass, having sedative and anxiolytic properties, effectively reducing anxiety. Additionally, it exhibits anti-inflammatory and antioxidant actions[21].

In addition to citral, the essential oil contains notable constituents such as neointermediol, methyheptenone, eudesma, decanal, and naphthalene[5]. Recent analyses of *Cymbopogon citratus* (lemongrass) essential oil have revealed the presence of further compounds, including elemol, β -eudesmol, cubebol, humulene, citral acetate, citral diethylacetal, verbenone, sabinene, and geranyl acetate."These compounds contribute to the medicinal and aromatic attributes of *Cymbopogon citratus*, and their diverse concentrations may affect the

plant's therapeutic potency[8]. Lemongrass essential oil is predominantly sourced from the leaves of the lemongrass plant, scientifically known as *Cymbopogon citratus* or *Cymbopogon flexuosus*. It is extracted via steam distillation, with the oil content in the leaves typically ranging from 1-2% of the dry weight. This translates to approximately 1 to 2 grams of essential oil per 100 grams of dried leaves, though this percentage can vary depending on factors like plant type, cultivation conditions, and extraction methods. Renowned for its citrusy scent reminiscent of lemons, lemongrass essential oil finds application in aromatherapy, perfumery, and as a flavor enhancer in the culinary industry. Its potential therapeutic benefits, such as its ability to combat microbes and reduce inflammation, are also highly esteemed[10].

- **Major Aldehydes in Lemongrass oil:** Citral, Geraniol, and Neral collectively make up approx 75.00% of the aldehydes present in lemongrass oil. These aldehydes contribute to the characteristic aroma of lemongrass and play a significant role in aromatherapy[29].
- **Triterpenoids and Flavones Isolated:** Two triterpenoids, cymbopogone, and cymbopogonol have been isolated from lemongrass parts. Flavonoids identified include "luteolin". Luteolin is a flavonoid compound found in various plants, known for its antioxidant and anti-inflammatory properties.[9,31].
- **Chemicals Extracted from Lemongrass:** Various chemicals have been extracted from different parts of lemongrass by researchers. Some of them include: Citral isomers (Citral β), Monoterpenols like Nerol and Geraniol, Lemonal (Citronellal), Terpinolene Geranyl esters like, Geranyl acetate, Myrcene, Terpinol methylheptenone[6].

Table 1: Essential components of Lemongrass[9].

Compound	Description	Function/Properties
Citral	Major component, responsible for lemony scent/flavor	Aromatic, antimicrobial
Myrcene	Herbal, slightly fruity aroma, potential sedative effect	Aromatic, sedative, muscle relaxant
Limonene	Citrus aroma, potential antioxidant, anti-inflammatory	Aromatic, antioxidant, anti-inflammatory
Geraniol	Floral scent, antimicrobial, insect-repelling	Aromatic, antimicrobial, insect-repellent
Nerol	Floral aroma, potential antioxidant, anti-inflammatory	Aromatic, antioxidant, anti-inflammatory
Citronellol	Citrusy scent, insect-repelling	Aromatic, insect-repellent
Linalool	Floral aroma, potential sedative, anti-anxiety effects	Aromatic, sedative, anxiolytic

3. PHARMACOLOGICAL ACTIONS OF LEMONGRASS

Lemongrass (*Cymbopogon citratus*) has been extensively utilized in traditional practices across diverse cultures due to its medicinal attributes. While contemporary investigations have initiated the exploration of its potential health advantages, further research is required to establish conclusive evidence. Here are some of the potential health benefits associated with lemongrass:

- **Anti-Inflammatory Properties:** Lemongrass contains citral, which has shown promise in reducing inflammation. Given the link between inflammation and chronic diseases, its anti-inflammatory effects are of interest[26].
- **Anti-Filarial Activity:** Studies have explored lemon grass's potential in combating filarial infections, particularly relevant in regions where such diseases are prevalent[25].
- **Anti-Diarrheal Effects:** Traditional medicine has utilized lemongrass for gastrointestinal issues like diarrhea, possibly due to its antimicrobial properties[24].
- **Anti-Mycobacterial Activity:** Research suggests that lemongrass may have properties to combat Mycobacterium infections, including tuberculosis[22].
- **Anti-Bacterial and Anti-Fungal Properties:** Lemongrass exhibits activity against certain bacteria and fungi, indicating its potential as a natural antimicrobial agent[22,23].
- **Treatment of Respiratory Issues and Headaches:** Lemongrass's aroma makes it popular for addressing respiratory problems like coughs, and it's sometimes used to relieve headaches[32].
- **Alleviation of Constipation:** Traditional practices have employed lemongrass for constipation relief, likely due to its mild laxative effects[32].
- **Potential for Malaria Treatment:** While lemongrass has been traditionally used for malaria, further research is necessary to determine its efficacy[32].
- **Treatment of Pneumonia and Vascular Problems:** Traditional uses suggest lemongrass may have benefits in treating conditions like pneumonia and vascular issues. However, scientific evidence supporting these claims is limited[30].

It is crucial to acknowledge that although lemongrass exhibits potential in these domains, additional research is necessary to comprehensively comprehend its modes of operation and to determine recommended dosages for therapeutic intentions. As with any herbal remedy, individuals should exercise caution, especially if they are pregnant, nursing, or have underlying health conditions. Consulting with a healthcare professional is advisable before using lemongrass or any herbal remedy for medicinal purposes[11].

4. CONCLUSION

In conclusion, this review provides a comprehensive overview of Lemongrass (*Cymbopogon citratus*), emphasizing its ethnological, pharmacological, and chemical aspects, with a particular focus on its efficacy as a natural insect repellent. Lemongrass possesses a diverse range of medicinal properties attributed to its rich phytochemical composition, including compounds such as citral, geraniol, limonene, citronellal, myrcene, and linalool. These compounds contribute to its therapeutic effects, including anti-inflammatory, antimicrobial, and antioxidant properties. The review highlights Lemongrass's historical significance in traditional medicine, particularly in combating mosquito-borne illnesses. Its potential as a natural alternative to synthetic insect repellents, such as DEET, is underscored, with studies suggesting its effectiveness in repelling mosquitoes. Furthermore, Lemongrass exhibits various pharmacological actions, including anti-inflammatory, anti-filarial, anti-diarrheal, and anti-bacterial properties, among others. However, while Lemongrass shows promise in various health domains, further research is warranted to fully understand its mechanisms of action and determine recommended dosages for therapeutic use. Additionally, caution should be exercised, especially among vulnerable populations, and consultation with healthcare professionals is

advisable before incorporating Lemongrass or its extracts into medicinal regimens. Overall, this review offers valuable insights into the potential benefits of Lemongrass and its role in promoting public health, particularly in mosquito control and disease prevention. The formulation and evaluation of the herbal mosquito repellent lotion proved successful in creating an effective, stable, and safe product.

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