

REVIEW ON CYMBOPOGON CITRATUS

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ABSTRACT

Lemon grass, commonly referred to as citronella grass, is part of the Poaceae family and belongs to the genus Cymbopogon. This genus includes around 140 species that thrive widely in semi-temperate and tropical regions of Asia, the Americas, and Africa, with only a few species found in Australia and Europe. In English, lemon grass is sometimes called “Squinant” and is known by various local names globally. Members of the Cymbopogon genus are also called aromatic grasses due to their production of volatile oils.(1,2)

The distinct lemon scent of this grass is primarily due to the high citral content in its oil(3). This fragrance makes it ideal for use in products like soaps and detergents. As a rich source of citral, it is also widely used in the perfume and food industries. Additionally, it serves as the starting material for producing ionones, which are essential in the synthesis of Vitamin A.(4)

Lemon grass contains various bioactive compounds that contribute to its medicinal properties, with substantial evidence supporting its ethnopharmacological uses(5). According to the WHO, herbal medicine is a vital component of healthcare for over two-thirds of the population in developing countries. In addition to providing an overview of lemon grass, this review emphasizes its medicinal qualities, showcasing its potential for pharmacognostic applications(6).

1. INTRODUCTION

Brief History

Lemon grass, a perennial plant typically grown in subtropical and tropical regions, includes two main species: West Indian (*Cymbopogon citratus*) and East Indian (*Cymbopogon flexuosus*). Various species of lemon grass are native to Southeast Asia, South Asia, and Australia, which is why *Cymbopogon flexuosus* is often called tropical Asia East Indian lemon grass. Also known as Cochin or Malabar grass, this species is native to Sri Lanka, India, Thailand, and Burma, while *Cymbopogon citratus* represents West Indian lemon grass. Both species are now cultivated worldwide(7).

In the Philippines, lemon grass was distilled for export as early as the 17th century. Citronella oil, closely related to lemon grass oil, was first showcased at the World’s Fair at London’s Crystal Palace in 1951. In India, lemon grass has long been popular, known locally as “choomana polu,” referring to its red grass stem(8). Indigenous Australians also used citrus fruits to create a drink and as a wash for skin cuts and eyes(9).

Commercial cultivation of lemon grass occurs in countries like India, Guatemala, Paraguay, China, Sri Lanka, England, and parts of Africa, Indochina, and the Americas. These plants grow in dense clumps, up to 2 meters in diameter, with leaves reaching about 1 meter in length. The genus is native to South Asia, Australia, and Southeast Asia(10).

Lemongrass is widely used in herbal teas, non-alcoholic beverages, baked goods, and confections. Its essential oil is a popular ingredient in perfumes, cosmetics such as creams and soaps, and as a fragrance in detergents. Citral, extracted from lemongrass oil, is used to flavor soft drinks, scent soaps, and masks unpleasant odors in various industrial products. It also plays a role in producing ionones, which are used in perfumery.

As a medicinal plant, lemongrass is known for its insect-repellent and carminative properties. West Indian lemongrass has been reported to exhibit strong antimicrobial activity, while its essential oils act as central nervous system depressants. The essential oils from East Indian lemongrass have potent antifungal effects. Additionally, lemongrass oils have shown some mutagenic and pesticidal properties.

Cymbopogon nardus is a source of citronella oil, and *Cymbopogon martinii* is known to be toxic to fungi. Lemongrass is generally recognized as a safe plant extract and essential oil for human consumption. It’s a versatile plant, used not only to make flavorful herbal tea and in cooking but also as an efficient natural antibiotic and a barrier against weeds. The outer leaves can be used to add flavor to meals but should be removed before serving. Lemongrass is known for establishing itself quickly and being drought-tolerant(11).

Cymbopogon Citratus (Lemon grass)



Various Name of Lemon grass:-

Scientific Name:- Cymbopogon Citratus

Hindi Name :- Verveine.

Italian Name :- Cimbopogone.

Indonesian Name:- Sereh.

Malaysian Name:- Sakumau.

Brazilian Name:- Capim-Cidrao, Capim-Santo.

Thai Name :- Ta-Khrai.

English Name :- Citronella

Gujarati Name :- Lilicha

Swedish Name:- Citongrass

Mexican Name:- zacate Limon

Ethiopian Name:- Tej-sar

Turkish Name :- Limon out

Marathi Name:- Gavati Chaha

Botany, Morphology, Ecology :-

Lemongrass is a large, perennial sedge with dense rhizomes and thick clusters of leaves. It has an erect growth habit, reaching up to 1.8 meters in height. The leaves are long, green, and glaucous, tapering upwards with a linear shape and smooth margins. The ligule, found at the junction of the blade and leaf sheath, is very short. Its cylindrical sheaths form barren shoots that widen at the base, tightly clasping near the bottom, while others remain narrow and separate. Lemongrass is a short-day plant that produces abundant flowers, particularly in South India, with inflorescences reaching up to 1 meter long.(12).

As an aromatic plant belonging to the Gramineae family, lemongrass is known for its high-quality essential oils and cost-effective production. It grows in dense clumps, reaching upto 1 meter in height. The leaf blades are linear, tapering at both ends, and can grow up to 50 cm long and 1.5 cm wide. The tubular leaf sheaths form a pseudo-stem, and the plant produces flowers during its mature growth stages.

Biological Source:-

Lemongrass oil is obtained from Cymbopogon flexuosus Stapf. (syn. Andropogonnardus var. flexuosus Hack.), belonging to family Poaceae. It contains not less than 75% of aldehydes calculated as citral

Taxonomical Classification of Lemon grass:-

Kingdom : Plantae

Division : Magnoliophyta

Class : Liliopsida

Order : Poales

Family : Poaceae

Genus : Cymbopogon

Species : citratus

Chemical Composition

Lemongrass (Cymbopogon citratus) is widely known for its high citral content. The timing of harvesting—whether too early or delayed—can significantly impact the essential oil yield and citral concentration. Factors such as temperature, light intensity, soil moisture, fertilization, and plant maturity all influence the production of essential oils and citral components. As the plant matures, it transitions from the vegetative to the reproductive stage, with essential oil yield closely linked to plant biomass. Optimal citral content, around 75%, is achieved when harvested at a specific growth stage, determined by the ratio of young to older leaves.

Essential oils from lemongrass are extracted using various methods, including solvent extraction, accelerated solvent extraction with dense CO₂, Soxhlet extraction, solid-phase matrix extraction, and supercritical fluid extraction. Advanced analytical techniques such as high-performance liquid chromatography (HPLC) combined with gas chromatography (GC) are often used to analyze the complex composition of essential oils. HPLC effectively separates broad classes of compounds, which can then undergo further separation with GC for more detailed analysis.

Bioactive Compounds Present in Lemon Grass and its Oil:-

Lemongrass has a wide range of ethnopharmacological uses, which can be attributed to the variety of secondary metabolites it produces. Studies have revealed that it contains fats, proteins, carbohydrates, fiber, minerals, and numerous bioactive compounds. These compounds fall into several categories, including alkaloids, terpenoids, flavonoids, phenols, saponins, and tannins. Additionally, research has confirmed the presence of anthraquinones, steroids, phlobotannins, and cardiac glycosides in lemongrass. These components contribute to its health-restorative properties(14,15).

Table : 1 Nutritional Content of Lemon grass(3):-

Sr no	Nutritional Components	Quantity
1	Carbohydrate	55.00%
2	Crude Fat	5.10%
3	Crude Protein	4.56%
4	Crude Fiber	9.28%
5	Energy	360.55 al/100g

Medicinal Properties of Lemon Grass and its Oil :-

Lemongrass has traditionally been used to treat a wide range of medical conditions, thanks to its diverse secondary metabolites. It has been employed in remedies for fever, cough, elephantiasis, flu, leprosy, malaria, and digestive issues, among many other ailments. Its use in Ayurveda remains significant today due to its therapeutic properties. Given the adverse effects often associated with conventional medicine, plant-based alternatives like lemongrass have gained popularity. As a result, this herbaceous plant holds great potential for various applications in the pharmaceutical industry(16, 17).

Indonesian scientists have studied and confirmed that β -citronellol, the primary component of “Sereh Wangi” (the local name for lemongrass in Indonesia) oil, can reduce the weight of rats fed a high-fat diet. Inhaling β -citronellol vapors enhances sympathetic nerve activity in the rats, leading to increased activity in adipose tissue and subsequent weight loss. This study is significant because β -citronellol reduces body mass without impacting liver enzyme concentrations or activity. Weight loss is just one of the many benefits associated with citronella grass(18).

Maintaining oral health is a crucial part of daily routines, as conditions like gingivitis and periodontitis arise from dental plaque. Numerous studies indicate that these dental issues can increase the risk of ischemic stroke and cardiovascular disease. Research has shown that lemongrass exhibits antagonistic activity against both the planktonic and biofilm forms of *Candida dubliniensis*, a common oral pathogen. Therefore, citronella grass could be utilized in the development of herbal medications for oral healthcare(19,20).

Medical conditions such as hyperlipidemia, hypercholesterolemia, and hyperglycemia can lead to metabolic disorders like obesity and diabetes mellitus. Lemongrass has been reported to possess hypolipidemic, hypocholesteremic, and hypoglycemic properties. Studies have shown that consuming lemongrass extracts can reduce plasma cholesterol and very low-density lipids, both of which are closely linked to heart disease. A hypoglycemic effect was observed in rats after 42 days of administering a dose of 500 mg/kg/day of lemongrass extract, although the exact mechanism of action remains unclear(21,22). In addition to these benefits, several studies have also confirmed the anti-inflammatory, anticonvulsant, and anxiolytic effects of lemongrass extracts(23,24).

2. MATERIALS AND METHODS

1. Field Planting and Agronomic Practices

In March 2016, lemongrass stalks were planted on a private farm in Bilbeis City, Sharqia Governorate, Egypt. The planting area was organized into four terraces, each measuring 80 cm in width and 6 meters in length. Stalks were cultivated on both sides of the terraces, with a spacing of 30 cm between plants, resulting in a total of 160 plots. Standard agricultural practices were followed, and a drip irrigation system was utilized for watering. An organic farming approach was employed, Incorporating 10 m³ of compost per acre (Feddan) into the soil before planting.(25)

The plants were harvested by cutting the shoots 10 cm above the ground at intervals of 4, 8, and 12 months after planting. During this time, plant height, shoot fresh weight, and shoot dry weight were recorded. Leaf area was measured, and total chlorophyll content was assessed using a SPAD chlorophyll meter (SPAD-502plus, Konica Minolta, INC., Osaka, Japan). The harvested shoots were then air-dried for further chemical analysis.(25)

2 Total Phenolic, Total Flavonoids and DPPH Analysis

Dried shoots (5 g) were ground and subjected to hydroalcoholic extraction using a Soxhlet apparatus. The extracts were then concentrated and dried using a rotary evaporator under reduced pressure, and subsequently dissolved in 100 mL of 80% methanol. The total phenolic content was assessed using the Folin-Ciocalteu method with some modifications.

In brief, 100 μ L of the extract was transferred to a test tube, and the volume was adjusted to 3.5 mL with distilled water. This mixture was oxidized by adding 250 μ L of Folin-Ciocalteu reagent. After allowing the mixture to stand for 5 minutes, it was neutralized with 1.25 mL of a 20% aqueous sodium carbonate (Na_2CO_3) solution. After a further 40 minutes, the absorbance was measured at 725 nm against a solvent blank using a UV-Visible spectrophotometer. Gallic acid was used as the standard, and the total phenolic content was expressed as milligrams of Gallic Acid Equivalents (mg GAE)(26).

The total flavonoid content was measured using the aluminium chloride colorimetric assay. In this method, 300 μ L of 5% sodium nitrite (NaNO_2) was mixed with 100 μ L of the extract. After allowing the mixture to stand for 6 minutes, 300 μ L of a 10% AlCl_3 solution was added, and the total volume was adjusted to 2.5 mL with distilled water. Following a further 7 minutes, 1.5 mL of 1 M NaOH was added to the mixture, which was then centrifuged at 5000g for 10 minutes. The absorbance of the supernatant was measured at 510 nm against a solvent blank using a UV-Visible spectrophotometer. Catechin was used as the standard, and the total flavonoid content was expressed as milligrams of Catechin Equivalents (mg CE)(27).

The free radical scavenging capacity of the extracts was assessed using the stable DPPH assay(28). The final concentration of DPPH was set at 200 μ M, and the total reaction volume was 3 mL. After incubating the mixture in the dark for 60 minutes, the absorbance was measured at 517 nm against a blank of pure methanol. The inhibition of the DPPH free radical was calculated using the following equation:

$$\text{Inhibition (\%)} = \frac{(\text{A}_{\text{blank}} - \text{A}_{\text{sample}})}{\text{A}_{\text{blank}}} \times 100$$

Where A_{blank} is the absorbance of the blank reaction and A_{sample} is the absorbance of the test compound. The extract concentration required to achieve 50% inhibition (IC_{50}) was determined through linear regression analysis(28).

3 Hydro-Distillation and GC Mass Analysis:-

Fresh shoots (50 g) were hydro-distilled for three hours using a Clevenger-type apparatus(29). The extracted essential oils were collected and dried with anhydrous sodium sulfate for the identification of chemical constituents. Gas chromatography-mass spectrometry (GC-MS) analysis was conducted at the Department of Medicinal and Aromatic Plants Research, National Research Center, using a TRACE GC Ultra Gas Chromatograph (THERMO Scientific Corp., USA) coupled with a THERMO mass spectrometer detector (ISQ Single Quadrupole Mass Spectrometer).

The GC-MS system was equipped with a TG-WAX MS column (30 m x 0.25 mm i.d., 0.25 μ m film thickness), and analyses were performed using helium as the carrier gas at a flow rate of 1.0 mL/min and a split ratio of 1:10. The temperature program was set as follows: 40 $^{\circ}\text{C}$ for 1 minute, then increased at a rate of 4.0 $^{\circ}\text{C}/\text{min}$ to 160 $^{\circ}\text{C}$ (held for 6 minutes), followed by an increase of 6 $^{\circ}\text{C}/\text{min}$ to 210 $^{\circ}\text{C}$ (held for 1 minute). The injector and detector were maintained at 210 $^{\circ}\text{C}$, and diluted samples (1:10 hexane, v/v) of 1 μ L were injected. Mass spectra were obtained via electron ionization (EI) at 70 eV, with a spectral range of m/z 40-450.

The chemical constituents were Identified using two analytical methods: (a) mass spectra from authentic chemicals, the Wiley spectral library collection, and the NIST library, and (b) Kovats indices (KI) in reference to n-alkanes (C9-C22), matching them with published data from the National Institute of Standards and Technology(30).

4. Statistical Analysis

Plant samples were selected randomly for the study. The experiment included four replicates, with each replicate comprising 40 plots. Four individual samples were taken from each cut, and the mean values were calculated for analysis.

Domestic Uses:-

1. Cooking

Lemongrass is a common ingredient in Thai, Balinese, and Vietnamese cuisine. It's used to flavor curries, soups, stews, salads, grilled fish, and meat. You can also steep or boil fresh or dried lemongrass to make tea.

2. Natural remedy

Lemongrass is used as a natural remedy for digestive issues, neurological problems, high blood pressure, and pain. It's also traditionally used to reduce fever.

3.Manufacturing

Lemongrass extract is used in soaps, candles, disinfectants, and insect repellants. Lemongrass oil is used in hair shampoos and to make essential oils.

4.Other uses

Lemongrass is used to make vitamin A and natural citral. It may also help prevent the growth of some bacteria and yeast

Commercial Uses:-

1.Food and beverage

Lemongrass is a flavoring agent and food preservative. It's a staple ingredient in Southeast Asian cuisines, and is used in dishes like Tom Yum soup and satay. Lemongrass essential oil can also improve the quality of yogurt by preventing spoilage.

2.Perfumery and cosmetics

Lemongrass oil is a key component of many perfumes, cosmetics, and soaps because of its strong citrus scent.

3.Medicines

Lemongrass is believed to have medicinal properties, and is used to treat stomachaches, fevers, digestive problems, and inflammation. Some studies suggest that lemongrass oil can help calm headaches.

4.Insect repellent

Lemongrass oil is used in insect repellents because of its citrus scent.

5.Vitamin A

Ionone, a compound derived from lemongrass oil, is used to produce vitamin A.

6.Antioxidants

Lemongrass has antioxidant properties, which can help neutralize free radicals that can damage cells.

Medicinal Uses:-

1.Treating infections

Lemongrass oil has antifungal properties that can help treat yeast infections and oral thrush. It can also help prevent bacteria and yeast growth.

2.Reducing inflammation

Lemongrass contains citral, a natural plant compound that can help reduce inflammation.

3.Treating digestive issues

Lemongrass can help with stomach pain and other gastrointestinal issues.

4.Improving oral health

Lemongrass can help improve oral health.

5.Managing blood pressure

Lemongrass tea can help control blood pressure.

6.Treating anemia

Lemongrass tea can help treat anemia.

7.Improving skin health

Lemongrass oil can help improve skin health and give you glowing skin.

8.Treating periodontitis

Lemongrass oil can be used as an adjunct to scaling and root planing to treat chronic periodontitis.

9.Reducing anxiety and insomnia

Lemongrass can help manage anxiety and insomnia.

10.Reducing cholesterol

Lemongrass can help lower cholesterol

Adulterant used instead of lemongrass:-

1.Adding similar oils

To make lemon oil smell more like lemon, producers may add beta-pinene, gamma-terpinene, and myrcene to orange oil.

2. Using cheaper citrus

To save money, producers may use cheaper citrus like mandarin, tangerine, or clementine to make adulterated lemon oil.

3. Adding synthetic materials

Adulterants may include cheaper essential oils or synthetic materials.

4. Diluting with vegetable oils

Adulterants may dilute the essential oil with vegetable oils.

Adulteration in essential oils can be detected by analyzing the enantiomeric composition of chiral components or calculating the percent normalized areas of selected markers.

Substitute drug used instead of lemongrass

1. Lemon or lime juice

A simple substitute, but the citrus flavor won't fully replicate lemongrass

2. Lemon zest

Grate it into your dish for a citrusy flavor and freshness

3. Lemon verbena

A herb that some say is a better substitute for lemongrass than lemon

4. Lemon balm

Has a lighter flavor than lemongrass, but it gives off a zesty scent that's good for aromatic teas

If you're using ground lemongrass powder, you can substitute 1 teaspoon of ground for one stalk of fresh lemongrass

Per hectare percent yield of lemongrass

The average yield of lemongrass per hectare is 25–30 tonnes of fresh herbage per year, which yields about 80 kg of oil. However, the yield can vary depending on the variety, harvesting age, and irrigation conditions:

Variety

The Lomisar-I variety has a higher essential oil content than the WG-Lomisar-UA variety.

Harvesting age The highest fresh herbage yield is obtained when the WG-lomisar-UA variety is harvested 135 days after planting, while the highest dry herbage yield is obtained when harvested 195 days after planting.

Irrigation

Under irrigated conditions, newly bred varieties can yield 100–150 kg of oil per hectare.

Lemongrass is a member of the grass family and is also known as barbed wire grass, silky heads, oily heads, Cochin grass, Malabar grass, citronella grass, or fever grass. It is commonly cultivated as a culinary and medicinal herb because of its lemon-like scent.

Per kg evolution of lemongrass

Peroxide value

The peroxide value of lemongrass oil can be used to determine its oxidative rancidity and antioxidant level. A peroxide value of 14.2 meq/kg indicates high oxidative rancidity and low antioxidant levels.

Essential oil yield

The essential oil yield of lemongrass can vary depending on the cultivar and season of harvest. For example, the cultivar Krishna has an average citral content of around 80% and an essential oil yield of 2.35 L per 100 m².

Phytochemical and medicinal value

Lemongrass powder contains more fiber and ash than wheat flour. It also contains higher levels of essential minerals, such as calcium, magnesium, potassium, iron, and zinc.

Antioxidant properties

The antioxidant capacity of lemongrass tea infusion can be affected by the duration of extraction and the temperature of exposure.

Lemongrass is a tall perennial grass with large leaves and a unique scent. It is a member of the Graminae family and is known as the "sweet grass family". Lemongrass is a rich source of vitamins and minerals, including vitamins A, B1, B2, B3, B5, B6, B9, and ascorbic acid

3. CONCLUSION

Lemongrass (*Cymbopogon citratus*) is a versatile herb known for its distinct citrus flavor and aroma, commonly used in cooking, particularly in Southeast Asian cuisine. Its benefits extend beyond culinary uses:

1. **Culinary Uses:** Lemongrass adds a refreshing flavor to dishes such as soups, curries, and teas. It can be used fresh, dried, or as an oil, enhancing both taste and aroma.
2. **Health Benefits:** Rich in antioxidants, lemongrass is thought to have anti-inflammatory, antimicrobial, and antifungal properties. It is also used in traditional medicine for digestive issues, stress relief, and as a natural remedy for fever and cold.
3. **Aromatherapy and Beauty:** The essential oil derived from lemongrass is popular in aromatherapy for its uplifting scent and is often included in beauty products for its astringent properties.
4. **Sustainability:** Lemongrass is relatively easy to grow, making it a sustainable choice for home gardens and commercial farming.

In conclusion, lemongrass is not only a flavorful addition to various dishes but also offers numerous health benefits and practical applications in aromatherapy and skincare. Its cultivation promotes sustainability, making it a valuable herb in both culinary and wellness contexts.

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