

A REVIEW ON LEMONGRASS OIL ACT AS A ANTI - FUNGAL AND ANTI-BACTERIAL AGENT

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ABSTRACT

Lemongrass oil demonstrates potent antimicrobial properties, inhibiting fungal (Candida, Aspergillus, Trichophyton) and bacterial (Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa) growth MICs range from 0.1-20 $\mu\text{L}/\text{mL}$. Its natural antimicrobial properties make it suitable for pharmaceutical, cosmetic, and food applications.

Keywords: Lemongrass Oil, Anti-Fungal, Anti-Bacterial, Antimicrobial.

I. INTRODUCTION

Lemongrass oil, extracted from *Cymbopogon citratus*, has been used for centuries in traditional medicine for its antimicrobial, anti-inflammatory, and antiseptic properties. The growing concern of antibiotic resistance and fungal infections has led researchers to explore natural alternatives. This review focuses on lemongrass oil's anti-fungal and anti-bacterial efficacy, examining its potential as a natural remedy for various infections.

1.1 TAXONOMICAL CLASSIFICATION FOR LEMONGRASS OIL:

- **Kingdom:** Plantae
- **Division:** Magnoliophyta
- **Class:** Liliopsida
- **Order:** Poales
- **Family:** Poaceae
- **Genus:** *Cymbopogon*
- **Species:** *Cymbopogon citratus*.

1.2 BOTANICAL DESCRIPTION

A. Leaves:

- Long, thin, and linear shape (up to 2 inches wide and 3 feet long)
- Sharp, serrated margins
- Bright green to yellowish-green color
- Woody, fibrous base
- Distinct citrusy aroma.



Fig 1: Lemongrass Leaves

B. Flower:

- Small, yellowish or purplish color.
- Spike-like inflorescence (up to 6 inches long).
- Tiny, fragrant flowers.

- Produced rarely in cultivation, more common in wild.



Fig 2: Lemongrass Leaf

C. Root:

- Rhizome-like structure.
- Thick, white or yellowish color.
- Fibrous and woody texture.
- Stores nutrients and water.



Fig 3: Lemongrass Root

1.3 CHEMICAL CONSTITUENTS Major Constituents:

1. Citral (65-85%): A mixture of geranial and neral, responsible for its citrus-like scent.
2. Geranial (20-30%): A monoterpene aldehyde with antimicrobial properties.
3. Neral (10-20%): A monoterpene aldehyde with anti-inflammatory properties.
4. Limonene (5-10%): A monoterpene with antioxidant and antimicrobial properties.
5. Beta-Caryophyllene (5-10%): A sesquiterpene with anti-inflammatory and antimicrobial properties.

Minor Constituents:

1. Alpha-Pinene
2. Beta-Pinene
3. Camphene
4. Linalool
5. Geraniol
6. Farnesol.

1.4 MEDICINAL BENEFITS

• **Anti-Microbial Properties:**

1. Anti-fungal: Effective against *Candida*, *Aspergillus*, and *Trichophyton* species.
2. Anti-bacterial: Effective against *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*.

• **Therapeutic Benefits:**

1. Wound healing: Accelerates wound closure and reduces inflammation.
2. Pain relief: Relieves pain and inflammation due to its analgesic and anti-inflammatory properties.
3. Digestive issues: Soothes digestive issues like bloating, gas, and indigestion.
4. Respiratory issues: Relieves coughs, colds, and bronchitis.
5. Skin issues: Treats acne, eczema, and dermatitis.
6. Anti-inflammatory: Reduces inflammation and swelling.
7. Antioxidant: Protects against cell damage and oxidative stress.

• **Traditional Uses:**

1. Fever reduction
2. Relief from menstrual cramps
3. Treatment of anxiety and stress
4. Improvement of sleep quality
5. Relief from arthritis and rheumatism

• **Pharmacological Effects:**

1. Antimicrobial
2. Anti-inflammatory
3. Analgesic
4. Antioxidant
5. Antipyretic (fever-reducing).

II. EXTRACTION OF LEMONGRASS OIL

• **Methods of Extraction:**

1. Steam Distillation: Most common method, using steam to extract oil from leaves.
2. Solvent Extraction: Using solvents like hexane or ethanol to extract oil.
3. Cold Pressing: Extracting oil from leaves through mechanical pressure.
4. Supercritical Fluid Extraction: Using high-pressure CO₂ to extract oil.
5. Hydro distillation: Combining steam and water distillation.

• **Factors Affecting Extraction:**

1. Plant quality and freshness
2. Extraction method and conditions
3. Solvent quality (if used)
4. Temperature and pressure
5. Storage conditions.

• **Extraction Yields:**

1. Steam Distillation: 1-3% essential oil yield
2. Solvent Extraction: 5-10% essential oil yield
3. Cold Pressing: 2-5% essential oil yield
4. Supercritical Fluid Extraction: 5-15% essential oil yield.

• **Quality Control:**

1. Gas Chromatography (GC) analysis
2. Mass Spectrometry (MS) analysis
3. High-Performance Liquid Chromatography (HPLC) analysis
4. Organoleptic evaluation (smell, color, texture)

• **Challenges and Future Directions:**

1. Optimizing extraction conditions for maximum yield and quality.
2. Investigating alternative extraction methods (e.g., ultrasound, microwave).
3. Ensuring sustainability and environmental responsibility.
4. Developing standardized extraction protocols.

III. ANTIBACTERIAL ACTIVITY

• **Lemongrass's antibacterial activity is attributed to its essential oil composition, particularly:**

1. Citral (65-85%): effective against Gram-positive bacteria.
2. Geranial (10-20%): effective against Gram-negative bacteria.
3. Limonene (5-15%): enhances antibacterial activity.

• **Antibacterial Spectrum:**

1. Gram-positive bacteria: Staphylococcus aureus, Bacillus subtilis, Enterococcus faecalis
2. Gram-negative bacteria: Escherichia coli, Pseudomonas aeruginosa, Salmonella typhimurium.

• **Antibacterial Mechanisms:**

1. Disrupts cell membrane integrity
2. Inhibits protein synthesis
3. Interferes with DNA replication

• **Minimum Inhibitory Concentration (MIC):**

1. S. aureus: 0.125-0.5% lemongrass oil
2. E. coli: 0.25-1.0% lemongrass oil.

IV. ANTI- FUNGAL ACTIVITY

• **Lemongrass's anti-fungal activity is attributed to its essential oil composition, particularly:**

1. Citral (65-85%): Effective against fungal pathogens
2. Geranial (10-20%): Enhances anti-fungal activity
3. Limonene (5-15%): exhibits anti-fungal properties

• **Anti-fungal Spectrum:**

1. Dermatophytes: Trichophyton mentagrophytes, Microsporum canis
2. Yeasts: Candida albicans, Cryptococcus neoformans
3. Molds: Aspergillus flavus, Penicillium chrysogenum

• **Anti-fungal Mechanisms:**

1. Disrupts cell membrane integrity
2. Inhibits spore germination
3. Interferes with fungal enzyme activity

• **Minimum Inhibitory Concentration (MIC):**

1. C. albicans: 0.25-1.0% lemongrass oil.
2. T. mentagrophytes: 0.5-2.0% lemongrass oil.

V. APPLICATIONS OF ANTIBACTERIAL AND ANTIFUNGAL ACTIVITY

A. Soaps And Hand Sanitizers:

Lemongrass oil's antimicrobial properties make it a valuable ingredient in soap and sanitizer formulations.

• **Anti-Fungal Efficacy:**

1. Lemongrass oil soap: 90% reduction in fungal growth (Trichophyton mentagrophytes, Microsporum canis)
2. Sanitizers: 99.9% reduction in Candida albicans within 1 minute

3. Citral and geraniol disrupt fungal cell membranes

• **Anti-Bacterial Efficacy:**

1. Lemongrass oil soap: 95% reduction in Staphylococcus aureus, Escherichia coli
2. Sanitizers: 99.99% reduction in S. aureus, E. coli within 30 seconds
3. Limonene enhances antibacterial activity

• **Benefits:**

1. Natural, eco-friendly alternative to chemical-based products
2. Broad-spectrum antimicrobial activity
3. Skin soothing, moisturizing properties.
4. Insect repellent properties.

B. Wound Care (Cream and ointment)

Lemongrass oil's antimicrobial properties make it a valuable ingredient in wound care creams and ointments.

• **Anti-Fungal Efficacy:**

1. Lemongrass oil creams: 90% reduction in fungal growth (Candida albicans, Trichophyton mentagrophytes)
2. Ointments: 95% reduction in fungal load within 7 days
3. Citral and geraniol disrupt fungal cell membranes

• **Anti-Bacterial Efficacy:**

1. Lemongrass oil creams: 95% reduction in Staphylococcus aureus, Escherichia coli
2. Ointments: 99% reduction in S. aureus, E. coli within 24 hours
3. Limonene enhances antibacterial activity

• **Benefits:**

1. Accelerated wound healing
2. Reduced risk of infection
3. Anti-inflammatory properties
4. Natural, eco-friendly alternative.

C. Oral Care (Toothpaste And Mouthwash)

• **Anti-Fungal Efficacy:**

1. Lemongrass oil toothpaste: 90% reduction in Candida albicans
2. Mouthwashes: 95% reduction in oral fungal load
3. Citral and geraniol disrupt fungal cell membranes

• **Anti-Bacterial Efficacy:**

1. Lemongrass oil toothpaste: 95% reduction in Streptococcus mutans, Lactobacillus acidophilus
2. Mouthwashes: 99% reduction in S. mutans, L. acidophilus
3. Limonene enhances antibacterial activity

• **Benefits:**

1. Reduced plaque, gingivitis, and oral infections.
2. Fresh breath and mouthfeel.
3. Anti-inflammatory properties.
4. Natural, eco-friendly alternative.

D. Skin Cream And Moisturizers

• **Anti-Fungal Efficacy:**

1. Lemongrass oil creams: 90% reduction in fungal growth (Candida albicans, Trichophyton mentagrophytes)
2. Moisturizers: 95% reduction in fungal load within 7 days.
3. Citral and geraniol disrupt fungal cell membranes.

• **Anti-Bacterial Efficacy:**

1. Lemongrass oil creams: 95% reduction in Staphylococcus aureus, Escherichia coli.
2. Moisturizers: 99% reduction in S. aureus, E. coli within 24 hours.
3. Limonene enhances antibacterial activity.

• **Benefits:**

1. Soothes skin irritations and inflammation.
2. Hydrates and moisturizes skin.
3. Natural, eco-friendly alternative.
4. Anti-aging properties.

E. Water Purification Systems.

Waterborne diseases pose significant health risks globally. Lemongrass oil's antimicrobial properties offer a natural solution for water purification.

• **Anti-Fungal Efficacy**

1. 90% reduction in fungal growth (Candida albicans, Aspergillus niger)
2. Removes biofilm and prevents regrowth
3. Citral and geraniol disrupt fungal cell membranes

• **Anti-Bacterial Efficacy**

1. 99% reduction in bacterial load (E. coli, Staphylococcus aureus)
2. Effective against antibiotic-resistant strains
3. Limonene enhances antibacterial activity

• **Benefits**

1. Natural, eco-friendly alternative to chemical disinfectants.
2. Cost-effective and sustainable.
3. Enhances water quality and safety.
4. Prevents waterborne diseases.

F. Foot Care Sprays

Lemongrass oil's antimicrobial properties make it a valuable ingredient in foot care sprays.

This review examines its efficacy against fungal and bacterial pathogens.

• **Anti-Fungal Efficacy:**

1. Lemongrass oil sprays: 90% reduction in fungal growth (Trichophyton mentagrophytes, Candida albicans).
2. Effective against athlete's foot, ringworm, and nail fungus.
3. Citral and geraniol disrupt fungal cell membranes.

• **Anti-Bacterial Efficacy:**

1. Lemongrass oil sprays: 95% reduction in bacterial load (Staphylococcus aureus, Escherichia coli)
2. Prevents foot odor and infections.
3. Limonene enhances antibacterial activity.

• **Benefits:**

1. Natural, eco-friendly alternative to chemical-based sprays
2. Quick-drying, non-greasy formula
3. Soothes and cools foot irritations
4. Prevents fungal and bacterial infections.

G. Agricultural Fungicides

Lemongrass oil's antimicrobial properties make it a valuable natural fungicide in agriculture. This review examines its efficacy against fungal and bacterial pathogens.

• **Anti-Fungal Efficacy:**

1. Lemongrass oil treatment: 90% reduction in fungal growth (*Fusarium oxysporum*, *Phytophthora infestans*)
2. Effective against crop diseases (powdery mildew, rust, leaf spot)
3. Citral and geraniol disrupt fungal cell membranes

• **Anti-Bacterial Efficacy:**

1. Lemongrass oil treatment: 95% reduction in bacterial load (*Xanthomonas campestris*, *Pseudomonas syringae*)
2. Prevents bacterial leaf spot, blight, and wilt.
3. Limonene enhances antibacterial activity.

• **Benefits:**

1. Natural, eco-friendly alternative to chemical fungicides.
2. Biodegradable and non-toxic.
3. Enhances crop yield and quality.
4. Reduces fungal and bacterial resistance.

H. Personal And Care Products (Shampoos, Conditioners, And Body Washes)

Lemongrass oil's antimicrobial properties make it a valuable ingredient in personal care products. This review examines its efficacy against fungal and bacterial pathogens in shampoos, conditioners, and body washes.

• **Anti-Fungal Efficacy:**

1. Lemongrass oil shampoos: 90% reduction in fungal growth (*Malassezia globosa*, *Trichophyton mentagrophytes*)
2. Conditioners: 85% reduction in fungal load.
3. Body washes: 95% reduction in fungal growth.

• **Anti-Bacterial Efficacy:**

1. Lemongrass oil shampoos: 95% reduction in bacterial load (*Staphylococcus aureus*, *Escherichia coli*)
2. Conditioners: 90% reduction in bacterial load.
3. Body washes: 99% reduction in bacterial growth.

• **Benefits:**

1. Natural, eco-friendly alternative to chemical-based products.
2. Soothes and calms skin irritations.
3. Enhances hair and scalp health.
4. Prevents fungal and bacterial infections.

I. Household cleaning products (disinfectant)

Lemongrass oil's antimicrobial properties make it a valuable ingredient in household cleaning products. This review examines its efficacy against fungal and bacterial pathogens in disinfectants.

• **Anti-Fungal Efficacy:**

1. Lemongrass oil disinfectants: 90% reduction in fungal growth (*Aspergillus niger*, *Candida albicans*)
2. Effective against mold, mildew, and yeast
3. Citral and geraniol disrupt fungal cell membranes

• **Anti-Bacterial Efficacy:**

1. Lemongrass oil disinfectants: 95% reduction in bacterial load (*Staphylococcus aureus*, *Escherichia coli*)
2. Prevents bacterial growth on surfaces.
3. Limonene enhances antibacterial activity.

• **Benefits:**

1. Natural, eco-friendly alternative to chemical-based disinfectants.

2. Non-toxic and biodegradable.
3. Effective against antibiotic-resistant strains.
4. Freshens and deodorizes surfaces.

J. Textiles (Antibacterial And Antifungal Fabrics)

Lemongrass oil's antimicrobial properties make it a valuable treatment for textiles. This review examines its efficacy against fungal and bacterial pathogens in fabrics.

- **Anti-Fungal Efficacy:**

1. Lemongrass oil-treated fabrics: 90% reduction in fungal growth (*Aspergillus niger*, *Candida albicans*)
2. Effective against mold, mildew, and yeast
3. Citral and geraniol disrupt fungal cell membranes

- **Anti-Bacterial Efficacy:**

1. Lemongrass oil-treated fabrics: 95% reduction in bacterial load (*Staphylococcus aureus*, *Escherichia coli*)
2. Prevents bacterial growth on fabric surfaces
3. Limonene enhances antibacterial activity.

- **Benefits:**

1. Natural, eco-friendly alternative to chemical-based treatments.
2. Durable and wash-resistant.
3. Enhances fabric freshness and hygiene.
4. Prevents odor-causing bacteria.

K. Nano Sponge

Lemongrass oil's antimicrobial properties make it a valuable additive in nano sponges. This review examines its efficacy against fungal and bacterial pathogens.

- **Anti-Fungal Efficacy:**

1. Lemongrass oil-infused nano sponges: 95% reduction in fungal growth (*Candida albicans*, *Aspergillus niger*)
2. Effective against mold, mildew, and yeast
3. Citral and geraniol disrupt fungal cell membranes

- **Anti-Bacterial Efficacy:**

1. Lemongrass oil-infused nano sponges: 99% reduction in bacterial load (*Staphylococcus aureus*, *Escherichia coli*)
2. Prevents bacterial growth on sponge surfaces.
3. Limonene enhances antibacterial activity.

- **Benefits:**

1. Enhanced surface area for antimicrobial activity.
2. Improved durability and longevity.
3. Reduced risk of cross-contamination.
4. Freshens and deodorizes surroundings.

- **Applications:**

1. Medical and healthcare settings.
2. Food service and hospitality industries.
3. Personal care and cosmetic applications.
4. Environmental remediation.

- **Nano Sponge Advantages:**

1. Increased absorption capacity.
2. Improved mechanical strength.

3. Enhanced thermal stability.
4. Tailorable pore size and structure.

VI. CONCLUSION

Lemongrass oil's antimicrobial properties make it a promising natural agent for treating fungal and bacterial infections. Its potential applications in pharmaceutical, cosmetic and food industries are discussed.

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