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## A review: Extraction of essential oil from lemon grass as a preservative for animal products

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#### Abstract

Lemongrass (*Cymbopogon Citratus*) is a valuable family of grass known due to its flavoring and fragrance application. Nowadays lemongrass oil is gaining the attention of food technologists due to its prime chemical profile. Chemically active compounds like Citral, Neral, Geranyl acetate, Camphor, etc has noteworthy application in the area of food as well as pharmaceuticals. Through this review article, an attempt has been made to give some information regarding extraction of oil method available for extraction of oil has also been discussed application of this oil in food and pharmaceutical field is also mentioned to highlight its importance.

**Keywords:** Lemongrass, physicochemical properties, extraction, antioxidant activity, food, and pharmaceutical applications

#### Introduction

The lemongrass is also known as *Cymbopogon citratus*. Lemongrass a perennial plant. The long, thin leaves are a widely cultivated. Essential oils of medicinal plants in the tropics and some regions Subtropical regions of Asia, Africa, America. Essential oils are plant extracts of various plants Materials, not only from flowers, but also from Herbs, trees and various other plant materials. The volatile oil content of lemongrass is around 1-2% on a dry basis and extracted from leaves parts of the plants. The essential oil is yellow. The lemongrass essential oil has anti-inflammatory properties, antibacterial, and antioxidant properties. It is estimated the global number of plants is approximately 300,000 and about 10% of it contains essential oils and can be used as the source of their production [1]. Lemongrass is an aromatic plant belonging to Gramineae family, it is a tall, clumpy perennial plant. The grass grows to a height of 1 m. The leaves are straight. The ends are tapered and can grow to 50 cm. The 1.5 cm wide leaf sheath is tubular and serves as a pseudo stem. This plant blooms in the mature growth stage. Lemongrass is usually cultivated as ratoon crops. It is the first harvest 4 to 6 months after planting, then Harvest every 2 to 3 months Harvesting is done by cutting 20 cm above the ground Level [2]. The ideal condition for growing lemongrass is a warm and humid climate full sun and 250-330 cm of rainfall years, evenly distributed in most areas year. The temperature range is 20-30 °C. There are several varieties Lemongrass available in the market From Sugradhi OD 19 to CKP 25 [3]. Lemongrass is also known as East Indian lemongrass, West Indian lemongrass Malabar or Cochin is native to India, Sri Lanka, and Thailand. It is planted in Karnataka, Arunachal Pradesh, Tamil Nadu and other states in India. India has planted lemongrass on approximately 3000 hectares of land, mainly in Kanatga, Arunachal Pradesh, and Tamil Nadu. The annual output is between 300-350 tons [4]. The scientific classification of lemongrass.

1. Kingdom- Plantae
2. Order-Poales
3. Family- Poaceae
4. Genus- Cymbopogon
5. Species- *Cymbopogon citratus*

The lemongrass is known by different name various countries as India (Lemongrass), Brazil (Capim- Cidar), Egypt(Lemongrass), USA (Citronella), Malaysia (Sakumau), Thailand (Takhari), Italian (Cymbopogon), Ethiopia (Tej-Sar) [5]. The vanilla lemongrass essential oil with a dedicated lemon flavor. It is used in perfume, soap, cosmetic industry and treat fever and infection. Essential oil have been used in different household such as spices, food, and

beverages. Recently people have shown great interest in the cultivation of effect essential oil in aromatherapy [6]. These applications are due to the chemical profile of that oil contain citral (48%), Neral, Geranyl acetate, Geraniol, D-Limonene a combination of Neral and geraniol isomers is used as raw material for the production of ionone, Vit-A [7]. The essential oil have high commercial value. Extracting and characterizing bioactive molecules from medicinal plant is very important for drugs with high therapeutic value. One of the best ways to extract essential through different distillation method [8]. The main objective the to study the physicochemical properties of the lemongrass essential oil.

### Extraction Methods

- 1. Solvent Extraction Method:** Weigh 150 grams of dried lemongrass sample remove from the sliced lemongrass sample and put in 1 Ignite a clean flat-bottomed flask. 500ml n-hexane solvent was poured into a flask. The flask and contents are allowed to stand for 36 hours; this is done to extract all the oil components in the lemongrass. Then the extract is Pour into another 1-liter beaker. 200 ml ethanol are added to extract essential oils because they are essential the oil is soluble in ethanol. Then mix the mixture Transfer to a 500ml separatory funnel Separation through a process called liquid/liquid Separation process. Separated content the funnel is allowed to reach equilibrium, Divided into two layers (depending on their Density is different. Collect the lower ethanol extract and upper hexane into two separate 250ml beakers and place them in a 78°C water bath. This is done to remove the ethanol from leaving only natural essential oils. Oil production is determined by weighing the extract on an electronic scale Weigh the balance. The difference between the final weight and the initial weight of the beaker containing the extract the weight of the empty beaker gives the essential oil [9].
- 2. Steam Distillation Methods:** Put 150 grams of fresh lemongrass sample into 1 lighted round bottom flask with 250 ml of distilled water. The flask is equipped with a rubber stopper Connect to the condenser and heat. 0°C water Condensation through the condenser in the countercurrent to ensure steam. When water When it reaches 100°C, it starts to boil Essential oil from lemongrass. When the lemongrass is heated and the essential oil is extracted from leaves mixed with water vapor. Through the condenser and steam Condensed into liquid. With the use of ice cubes, Make cooling possible and volatilize Avoid using essential oils. Condensate is Use a 500ml beaker to collect directly, and then pour into the separatory funnel. This forms two Oil layer and water layer. Separated faucet Open the funnel to release water, and the oil Collect immediately 100ml stoppered bottle. The bottle is tightly closed to prevent the evaporation of essential oils. Oil is collected Weigh the volume of oil obtained [9].
- 3. Solvent Extraction Methods:** Pour 140 g of dried lemongrass sample from sliced lemongrass sample and 200 ml of ether solvent into the flask. Let the flask and contents stand for 18 hours. The extract was decanted into another beaker. 200 ml of ethanol was added to the extract. Separate the mixture in a separatory funnel. Collect the ethanol extract and ether layer into two

separate beakers. To remove ethanol, keep the sample in a water bath at 75-80 degrees Celsius. Determine the oil yield by weighing the extract [10].

- 4. Hydrodistillation Methods:** Put 500ml distilled water and 140g fresh lemongrass sample into Round-bottomed flask, the flask is equipped with a rubber stopper and connected to the condenser, and heating. Allow water to flow counter currently through the condenser, and heated. Allow water to flow counter currently through the condenser. After reaching the appropriate temperature, the essential oil, mixed with the water vapor was extracted from the leaves. The oil-water overhead product was skilled the condenser. The vapors were condensed and hence separated. Avoid volatilization by cooling with ice cubes. The condensate was collected using a beaker. Then use a separatory funnel to separate. Immediately collect the oil in the bottle with stopper and close tightly [10].
- 5. Enfleurage method:** Use a mortar and pestle to mash a 140 g sample of dried lemongrass (to expose the tighter inner stem). 70 ml of light-flavored olive oil and the smashed lemongrass were mixed in a beaker. The aluminum foils were used to cover the beaker. Then it had been shaken for distribution of the lemongrass. It was then allowed to stand for 18 hours at room temperature. 140ml ethanol was added to absorb the essential oil leaving behind the light-flavored olive oil and the lemongrass residue. To remove the ethanol, a sample was kept in the water bath at 75-80°C. The yield of oil was determined [10].

### Review of Literature

- Ranith *et al.*, (2014) Comparison of lemongrass (*Cymbopogon Citratus*) essential oil extracted by microwave-assisted water distillation (MAHD) and traditional water distillation (HD) methods. Studies on that the extraction of lemongrass essential oil used for Microwave-Assisted and Conventional Hydrodistillation method. The microwave-assisted hydrodistillation maximum of the yield of essential oil [1].
- Tajidin *et al.*, (2012) the chemical composition and citral content of essential oil of lemongrass (*Cymbopogon citratus*) in three mature stages. The hydrodistillation method was used for the extraction. Essential oil analyzed by the Gas Chromatography-Mass Spectroscopy. The essential oil Chemical composition a high citral content [2].
- Abera, (2020). Extraction and Physicochemical Analysis of Essential Oil from Arbaminch Lemongrass Leaves in Ethiopia. Studies determined the physicochemical properties of the essential such as Ph, acid value, saponification value, boiling temperature, and moisture content. The essential oil is used for soap production [6].
- Ali *et al.*, (2017). GC-MS analysis and antibacterial screening of lemongrass (*Cymbopogon citratus*) essential oil. Studies on the gas chromatography and mass spectroscopy and antimicrobial screening of lemongrass essential oil. The extraction by using the hydrodistillation method. Extracted essential oil analyzed by GC-MS and chemical constitutes like Citral, Neral, Geraniol, Citronellol. Anther studies on extracted oil from the antibacterial activity and antifungal activity [7].
- Dutta *et al.*, (2014). The quality of lemongrass (*Cymbopogon*

citrus) essential oil under different drying conditions. Studies on the different drying methods were used i.e. Shade drying, Oven drying, and sun-drying. Oven drying is the maximum yield of essential oil and is determined by the physicochemical properties (Saponification value, iodine value, acid value) of lemongrass essential oil<sup>[8]</sup>.

Suryawanshi *et al.*, (2016) Methodology to extract essential oils from lemongrass leaves studies on that the two extraction method was used i.e. solvent extraction and steam distillation. The steam distillation method was a high-yield and better method. The essential oil is used for the perfume<sup>[9]</sup>.

Shetty *et al.*, (2017). Laboratory-scale oil and perfume formulations extracted from locally available lemongrass leaves. Studies used for three methods i.e. Hydrodistillation method, solvent extraction method, and Enfleurage method. The solvent extraction method was 2.94gm essential oil per 140gm of lemongrass. The Enfleurage method was 2.74gm essential oil per 140gm lemongrass. 0.94gm of essential oil per 140gm of lemongrass. The solvent extraction method was high yield<sup>[10]</sup>.

Musthapa (2018). Comparative analysis of essential oils extracted from lemongrass and basil leaves. To determine the physicochemical properties of the lemongrass essential oil. The physicochemical properties Acid value, Boiling Temperature, Saponification value, Specific gravity, Refractive Index, Yield, Colour, and Solubility. The extracted essential oil was soluble in water they have good characteristics for the production of biofuel<sup>[11]</sup>.

Dangkulwanich *et al.*, (2020) Hydrodistillation and antimicrobial properties of lemongrass oil (*Cymbopogon citratus*, Stapf): An undergraduate laboratory exercise bridging chemistry and microbiology. The hydrodistillation method, soxhlet extraction, and solvent extraction method used for the extraction of essential oil. The soxhlet extraction method is maximum yield. The essential oil was tested for antimicrobial activity against gram-negative and gram-positive microorganisms<sup>[12]</sup>.

Ranade *et al.*, (2015) Lemon Grass. The lemongrass is an aromatic plant and medicinal properties. Microwave hydrodistillation method used for extraction of essential oil from *Cymbopogon citratus*. The lemongrass essential oil has used for cold, fever, malaria, and digestive problem. Other studies on the bioactive compound of the essential. The bioactive compound such as alkaloids, tannins, flavonoids, etc. The essential oil is used in soap, detergents, and perfumes<sup>[13]</sup>.

Throat *et al.*, (2017) the approximate and phytonutrient content of *Cymbopogon citratus* (Lemongrass) leaf extract and the preparation of herbal biscuits. Carried out research on the enrichment of lemongrass extract in cookies to enhance the nutritional properties of cookies. The final concentration (3%) of prepared cookies was found to be enriched in phenols, flavonoids, steroids, tannins, saponins, and alkaloids<sup>[14]</sup>.

Hanna *et al.*, (2012). Lemongrass (*Cymbopogon citratus*) essential oil is affected by drying methods. Studies on that the different drying method was used. Shade drying, oven drying, and sun drying. Oven drying has the highest essential oil of leaves dried by different drying methods. Lemongrass leaves dried in an oven at 45°C had the highest essential oil content (2.34%) on a dry weight basis<sup>[15]</sup>.

Adukwu *et al.*, (2016). Antibacterial activity, cytotoxicity and qualitative analysis of lemongrass volatile oil (*Cymbopogon flexuosus*) and pure citral. Determine the antibacterial activity

of lemongrass essential oil, and determine the cytotoxic effect of the two test compounds on human dermal fibroblasts. Application of essential oils in the management of drug-resistant infections<sup>[16]</sup>.

Godwin *et al.*, (2014). Determination of the element, phenolic, antioxidant and flavonoid properties of lemongrass (*Cymbopogon citratus* Stapf). Studies on that lemongrass have high antioxidant activity. The elemental compound like the K, Cl, Ca, Mg, Na, Al, Mn, and Cu the K, Cl, Ca, and Mg was in a higher concentration of the location. The total phenolic content of the hot percolation and cold percolation, interaction. The cold percolation extraction was low<sup>[17]</sup>.

Tyagi *et al.*, (2014). Chemical composition, *in vitro* anti-yeast activity, and fruit juice preservation potential of lemongrass oil. The lemongrass essential oil was used for the mixed fruit juice. The essential oil was analyzed by the GCMS. The minimum inhibitory concentration (MIC) level treated fruit juice odor and color persisted up to 4 days<sup>[18]</sup>.

Wu *et al.* (2019). Supercritical carbon dioxide extraction of essential oil from citronella leaves. Antioxidant and Antimicrobial Activities. In order to determine the antioxidant activity, the free radical scavenging activity of citronella leaf essential oil was measured by 1, 1-diphenyl-2-picrylhydrazine (DPPH). Another antibacterial activity study, such as two-fold dilution test and paper plate diffusion test<sup>[19]</sup>.

Khan *et al.*, (2018). Study of *Cymbopogon Citratus* (Lemongrass) Application for its Insecticidal Property – Ants and its Use in Preservation Methodology. The lemon grass leaves mixed with a ginger solution as ants repellent by applying its confectionary products candy with further application of it on preservation methodology<sup>[20]</sup>.

Majewska *et al.* (2019). Lemongrass (*Cymbopogon citratus*) Essential Oil: Extraction, Composition, Bioactivity and Uses for Food Preservation. Studies on that the extraction method used for the steam distillation method. The lemongrass essential oil use since ancient times in folk medicine as a remedy to improve circulation, stabilize menstrual cycles, promote digestion, or increase immunity, and another essential oil used for perfume, flavors, detergents, and preservatives. Chemical composition of the essential oil citral, neral, and geranyl acetate<sup>[21]</sup>.

Vázquez-Briones *et al.* (2015). The physicochemical and antioxidant properties of citronella essential oil. Studies on that the hydrodistillation method was used for extraction of essential oil. The essential oil was physicochemical properties such as Refractive index, density, and color parameters. Other studies on the to determine the antioxidant activity of the DPPH Essay. The lemongrass essential oil is used for tea<sup>[22]</sup>.

## Food and Pharmaceutical Applications

### Food Applications

Celina *et al.*, (2018) Application of Lemongrass Essential Oil as a Natural Preservative Agent for Pineapple Juice. Applied essential oil as preservatives for pine-apple juice which is highly prone to microbial contamination. The agar well diffusion method is used to screen the antibacterial activity of lemongrass essential oil against *Escherichia coli*, *Saccharomyces cerevisiae* and *Aspergillus Niger*<sup>[27]</sup>.

Santoso *et al.*, (2018) Lemongrass (*Cymbopogon citratus*) is used as a functional food ingredient with  $\alpha$ -glucosidase inhibitory activity. Carried out research on the yogurt fortified with 1500mg of lemongrass extract fail. The fortification of the lemongrass extract reduce the viscosity of yogurt<sup>[28]</sup>.

Tyagi *et al.*, (2014). Chemical composition, *in vitro* anti-yeast



activity, and fruit juice preservation potential of lemongrass oil. The lemongrass essential oil was used for the mixed fruit juice. The essential oil was analyzed by the GCMS. The minimum inhibitory concentration (MIC) level treated fruit juice odor and color persisted up to 4 days<sup>[29]</sup>.

Lonkar *et al.* (2013). Study on the preparation and preservation of tea-use Citronella (*Cymbopogon flexuosus* (Steud Wats)) powder. The lemon grass different varieties of lemongrass were blanched 80°C for 1 min and dried and fine powder. Varieties of lemongrass Kaveri, Praman, Pragati, OD\_19, and CKP-25. The powder sample was chemically analyzed for essential oil, ascorbic acid, chlorophyll<sup>[30]</sup>.

Hamad *et al.* (2019). Application of lemongrass as a natural preservative for tofu. Studies on that the lemongrass essential oil use for the natural preservative in tofu and lemongrass water extract was prepared according to the standard infusion method essential oil was made by steam distillation. The concentration is 20% lemongrass extract. Water inhibits the growth of bacteria. The tofu can be stored for 10days. Shelf life is 4 days<sup>[31]</sup>.

Abd-El Fattah *et al.* (2010). The potential of lemongrass extract as an antibacterial and food additive in yogurt. Studies on that there are two experiments the first experiment is 1ml spored suspension is incubated at 28°C for 14days. In another experiment, the yogurt medium was too different degree temperature (50°C and 280°C) for 4 weeks. In the first experiment, the growth of the mold and mycotoxins. The results show that adding proper concentration of EO (0.1%, w/v) improves the physical and chemical properties and sensory properties of yogurt, and can be used for decontamination and mycotoxin formation of dairy products such as mycotoxin-producing fungi in yogurt<sup>[32]</sup>.

Kate *et al.*, (2017). Pastry making with lemongrass as flavoring agent. Studies on that the lemongrass flavor agent used for the production of cake. The taste of lemongrass will be accepted by consumers, and sensory evaluation of lemongrass cake will be carried out. The cake development of the 400gm flour, 200gm sugar, 2spoon baking powder, lemongrass 2 spoon<sup>[33]</sup>.

### Pharmaceutical Applications

Nambiar *et al.*, (2012). Potential Function of Lemongrass (*Cymbopogon Citratus*) in health and disease. Studies on that the lemongrass was used for coughs, constipation, elephantiasis flu, gingivitis, headache leprosy, malaria, ophthalmia, pneumonia, vascular disease. It has been claimed to be anti-inflammatory properties and antioxidant properties<sup>[3]</sup>. Khan *et al.*, (2019) Study of eucalyptus and lemongrass essential oil Extracted by hydrodistillation methods. The essential oil is extracted from the lemongrass stem and eucalyptus leaves using the hydrodistillation method by the Clevenger apparatus. There are two types of lemongrass used i.e dry and wet basis. Eucalyptus oil has biological effects, has antibacterial, antiviral and antifungal ingredients, and has

a long history of use for colds, flu and other respiratory infections. The main operating parameters were studied on time and temperature 95<sup>o</sup>-103<sup>o</sup>C. The dry basis sample yield is high<sup>[34]</sup>.

Wifek *et al.*, (2016) Lemongrass: comments on its botany, properties, applications and active ingredients. Studies that lemongrass is a medicinal plant and increasing herbal resistance to pathogenic disease. The lemongrass essential oil has anti-depressant, analgesic, antipyretic, bactericidal, antiseptic, carminative, and astringent properties. Lemongrass is used in tea, non-alcoholic beverage, and baked products<sup>[35]</sup>.

Rajesvari *et al.*, (2016). Lemongrass oil for improvement of oral health. Studies on that the lemongrass essential oil used for the mouth rinse and toothpaste. The lemon grass has antibacterial, anti-inflammatory, anti-viral properties. The lemongrass essential oil has used for respiratory infection, bladder infection, high cholesterol, the digestive problem<sup>[36]</sup>.

Devi *et al.*, (2018). Effect of lemongrass oil on body pain. Studies on that the lemongrass essential oil is used the relieve muscle pain externally to kill bacteria. This research was conducted among 30 individual different groups with a different pain. 5ml lemongrass essential oil on their body for about 30days. According to the final result, regular uses for lemongrass oil has more chances for reducing our body pain<sup>[37]</sup>.

Promila, (2018). Phytochemistry and pharmacology of *Cymbopogon citratus* Stapf. (Lemon grass). Studies have shown that lemongrass has anti-inflammatory, anti-viral, anti-cancer, anti-hyperglycemic, anti-oxidant, anti-malaria, anti-mutation and antibacterial properties. These properties and chemicals in lemongrass make it a very important medicinal plant for the curing and prevention of various ailments<sup>[39]</sup>.

Meenapriya, (2017). The effect of lemongrass oil on rheumatoid arthritis. The study selected lemongrass oil for 30 participants with rheumatoid arthritis. They took lemongrass oil for about 30 days. The pain scale was noted every 2 to 3 days. The final result showed mild changes in the pain levels of the patient<sup>[40]</sup>.

**Table 1:** % extraction yield of lemongrass oil obtained through different methods

Sr. No	Extraction Method	Yield	References
1.	Hydrodistillation	0.98%	[1]
	Microwave-Assisted Hydrodistillation	1.46%	
2.	Soxhlet Extraction	6.27%	[6]
3.	Solvent Extraction	1.85%	[9]
	Steam Distillation	0.86%	
4.	Soxhlet extraction	2.50%	[11]
5.	Hydrodistillation	3.05%	[8]
6.	Solvent extraction	1.85%	[9]
	Steam distillation	0.86%	
7.	Solvent extraction	2.09%	[10]
	Hydrodistillation	0.946%	

**Table 2:** Chemical Compound

Chemical Compound	Percent concentration	References
β Myrcene, Geraniol, Citral, Citronellol, Neral, 1,3,4-trimethyl 3-cyclohexene-1 Carboxaldehyde	11.28, 5.54, 34.80, 1.34, 30.72, 2.20	[7]
Myrcene, Citronellal, Neral, Geranial,	12.39, 1.56, 42.15, 35.15,	[8]
Myrcene, a-Terpinolene, Linalool, Cis-Carveol, Neral, Geranial	15.69, 1.02, 1.03, 1.18, 34.98, 40.72,	[15]
Myrcene, Neral, Geranial, Citral, Geranic acid,	3.96, 35.69, 50.81, 86.48, 3.33	[1]
Neral, Geranial, Eudesm-7(11)-en-4-ol	34.11, 59.17, 2.20	[23]
Citral α, Citral β, Nerol, Geraniol, Citronellal, Terpinolene,	40.8, 32, 4.18, 3.04, 2.10, 1.23,	[5]

D-Limonene, Limonene, 1,7,7-Trimethylbicyclo[2.2.1]heptan-2-ol, Endo-borneol, Bicyclo[2.2.1]heptan-2-ol.1.7- trimethyl-(1S-endo), 1,3-Cyclooctadiene, 1-octen-3-yne, Furan,2-(2-propenyl), L-alpha.-Terpineol, alpha.-Terpineol, 8-Isopropenyl-1,5-dimethylcyclodeca-1,5-diene, Naphthalene,decahydro-1,6- bis(methylene)-4-(1-methylethyl),(4.alpha.,4.alpha.a.,8a.alpha.), Cyclohexane,1-ethenyl-1- methyl-2,4-bis(1-methylethyl)-,[1S- (1.alpha.,2.beta.,4.beta.), Caryophyllene, Bicyclo[7.2.0]undec-4-ene,4,11,11-trimethyl-8- methylene, Humulene, 1,4,7,cycloundecatriene,1,5,9, -tetramethyl, 1,6-Cyclodecadiene,1-methyl5-methylene-8-(1- methylethyl, 1HCyclopenta[1,3]cyclopropa [1,2]benzene,octahydro-7- methyl-3-methylene-4-(1- methylethyl)-,[3aS-(3a.al)], Cubebene, 4-epi-cubedol, Cubedol. Cis-muurola-3,5-diene, Naphthalene,1,2,3,5,6,8ahexahydro-4,7-dimethyl-1-(1- methylethyl),(1S-cis), Benzene,1,2,3-trimethoxy-5- (2-propenyl)-,	4.73, 4.73,6.75, 6.75, 6.75,1.49, 1.49, 1.49, 2.06, 2.06, 3.90, 3.90, 3.90, 11.24, 11.24, 1.79, 1.79, 3.60, 3.60, 2.71, 2.71, 2.76, 2.76, 2.76, 4.65, 48.00	[24]
1-methyl-1,3-Cyclohexadiene, Myrcene, 1,3,8-Menthatriene, Verbenene, eta-ocimene, beta-ocimene, para-Cymenene, 2,6-dimethyl-1,3,5,7-octatetraene, 2,3,5-Trimethyl-2,3,5-hexanetricarbonitrile, Isocitral, Trans-p-Mentha-2 8-dien, 5-isopropyl-2-methyl-cyclopent-1-enecarbaldehyde, Neral, Geranial, 2-Undecanone	3.76, 14.24, 7.20, 9.26, 1.28, 1.26, 6.42, 1.54, 1.55, 1.84, 6.65, 1.61,11.57, 20.45, 1.04	[25]
b-Myrcene, Neral, Geranial, Isopulegol, Geranyl acetate	7.45, 31.52, 42.16, 1.03, 4.3	[26]
2-hydroxy-1, 1, 10-trimethyl-6,9-decalin epidioxi, Oxirane methanol, 3-methyl-3-(4-methyl-3-pentenyl, Dihydroneopul, Neral, Geranial, Neric acid, 2-tridecanone, 7-Methyl-z-tetradecen-1-ol- acetate	8.09, 28.4, 2.52, 19.35, 15.97, 5.76, 9.15, 1.21, 2.37	[22]
Prenylacetone, b-Myrcene, 2 methyl 4,5 nanadiene, Limonene oxide, Neral, Geranial, Geranyl acetate, D-Cadinene, Juniper camphor, Viridifloral	1.84, 6.18, 3.14, 2.10, 32.86, 43.38, 1.87, 1.17, 3.86, 2.19	[31]
Citral $\alpha$ , Citral $\beta$ , Nerol, Geraniol, Citronellal, Terpinolene,	40.8,32, 4.18, 3.04, 2.10, 1.23,	[38]

**Table 3:** Physicochemical properties of lemongrass oil

Properties	Values	References
Acid Value	2.805	[6]
Saponification Value	140.25	
PH	5.5	
Boiling Point	212 <sup>o</sup> C	
Moisture Content	20.7	[11]
Acid Value	4.09	
Saponification Value	299	
Specific gravity	0.896	
Peroxide Value	6.0	[22]
Yield		
Refractive Index	2.487	
Solubility	Insoluble in water	
Colour	Dark Yellow	
Refractive index	1.483	
Density	0.873	
Color Parameter	97.04	

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