Review on Lemongrass Oil Extraction Methods, Properties & Its Mosquito Repellent Activity

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Abstract
Lemongrass (Cymbopogon citratus) belongs to the Poaceae family. It is a medicinal plant with compounds capable of controlling pathogens and increasing the resistance of herbs to pathogenic diseases. Lemongrass is commonly used in herbal teas and other non-alcoholic beverages. In baked goods, but also in sweets. Lemongrass essential oil is commonly used as a fragrance in perfumes and cosmetics such as creams and soaps. Lemongrass Essential Oil consists of a high content of Citral, which is used as a source for the production of beta-carotene and vitamin A, etc. Therefore, due to the presence of various chemical components in lemongrass oil, it is used in various pharmaceutical industries as antidepressant, analgesic, antipyretic, bactericidal, antiseptic, digestive and astringent properties.

Keywords: Lemongrass; Herbal Cosmetic; fragrance.

INTRODUCTION
Taxonomical and Botanical Description:
Lemon grass is a perennial monocotyledonous grass that could develop up to six ft. in top and 4 feet in width. It grows in clusters. It has long, slender, drooping vibrant inexperienced leaves that measures from 1.3-2.5cm in width and 3 feet in length. Leaves are easy with complete margins. Flowers develop on spikes. It has a prolonged inflorescence starting from 30-60cm. The floral association of this scented grass offers it the name ‘Cambroon’. Cymbopogon citratus is a not unusual place inhabitant of Southeast Asia. Taxonomic information of this lemon grass are as follow. [9]

Kingdom: Plantae
Division: Magnoliophyte
Class: Liliopsida
Family: Poaceae
Genus: Cymbopogon
Species: Citratus

Lemon grass is a tall plant having considerable striped leaves with a choppy edge. It is thought for its smoky, sweet, herbaceous and lemony fragrance. Cymbopogon flexuous is extensively applied in coaching of soups curries and teas. This herb incorporates calming character. Lemon grass (Cymbopogan flexuosus) is local sweet-smelling tall sedge. It is a family member Poaceae. It grows in severa elements of the tropical and subtropical South East Asia and Africa. Lemongrass is broadly used as important thing for health. In India it’s far use as sedatives for the primary worried system. Cymbopogon citratus an herb which is thought all through global as lemon grass is broadly used as a supply of drugs in tropical countries. Plant leaves are applied as tea and is normally utilized in Brazil as analgesic, antipyretic, spasmodylic, tranquilizer, anti-inflammatory and diuretic. Lemon grass important oil is comprised up of an excessive content material of central that is used as a supply for the manufacturing of beta carotene and nutrition A etc. Antimicrobial motion of Lemon grass oil is used for numerous pathogenic fungi.

A sturdy lemon fragrance, a most important characteristic of this grass, is because of the excessive central content material of its oil. The redolence of the oil allows its use in soaps, detergents, etc. As an amazing supply of central, it reveals a software with
inside the perfumery in addition to meals industries. It is likewise the beginning fabric for the manufacture of ionone’s, which produce Vitamin A. Lemon grass carries numerous bioactive compounds that impart medicinal fee to it. Considerable proof is to be had for its ethno pharmacological applications. According to the WHO, natural medication is taken into consideration a vital a part of the healthcare enterprise through extra than two-thirds of the populace in growing countries. The use of medicinal flowers is extra not unusual place amongst humans who've modest or no get right of entry to to scientific assistance. In Algeria, rose-scented geranium and lemon grass are used for the remedy of bacterial and fungal infections, and stomach-ache and toothache, respectively. Hence, some of research were posted whose goal turned into to assess the anti-inflammatory hobby of the natural or aqueous extracts of those flowers, both on human monocytes in vitro or on rodents in vivo. There is a big worldwide call for for the Essential oil of Cymbopogon species. Lemon grass critical oil is extracted through steam distillation from the dried or clean leaves of the plant. Steam distillation produces Essential oil plus hydrosols or fragrant waters, which might be regularly used towards inflammatory illnesses and microbial infectious. Lemon grass critical oil has sizeable business significance due to the fact it's far used with inside the manufacture of fragrances, flavours, perfumery, cosmetics, detergents, and Pharmaceuticals. Biological studies has proven that the diverse chemicals in Essential oil own antibacterial, antifungal, analgesic, and mosquito repellent properties. Lemongrass oil is used as antiseptic, antitussive, and anti-rheumatic and to deal with backache, sprains, and haemoptysis. Infusions of its leaves are utilized in opportunity medication as sedative, antimicrobial, and anti-inflammatory. In a few African countries, it's far used to deal with diabetes. The place of Algeria, in which conventional natural medication thrives, is wealthy in medicinal flora. Traditional practices primarily based totally on medicinal flowers exist amongst diverse tribes in Northern Algeria. Literature survey confirmed that only a few research were finished at the lemon grass plant grown in Algeria. It is therefore critical to analyse the chemical composition of Lemongrass critical oil and compare the healing ability of its unstable components. [6]

**Horticulture**

1. **Soil:**
   It can develop in types of soil starting from clayey to sandy, alluvial soil and loamy soil having excellent drainage device. It offers high-quality end result whilst grown beneath neath loamy-sand soils with excessive natural content. It may even tolerate negative soil. Avoid cultivation in soil that have negative drainage device or have lengthy water preserving capacity. Five.0-8.5five pH soil stages high-quality for the boom of the crop.

2. **Land Preparation:**
   For Lemongrass plantation, it calls for fertile and irrigated land. Ploughing and harrowing have to be completed repeatedly. During land guidance blend Lindale powder 10kg/acre with soil on the time of closing ploughing to shield the crop from the assault of termite. Transplantation of lemongrass is completed on raised beds.

3. **Sowing:**
   - **Time of sowing:** Prepare nursery beds in March - April month.
   - **Spacing:** Depending upon growth habit 60 cm x 60 cm spacing for seedlings and 90 cm x 60 cm spacing for slips is required.
   - **Sowing Depth:** Depth should be 2-3 cm.
   - **Method of sowing:** Two month old seedlings is ready for transplantation in main field.

4. **Seed:**
   - **Seed Rate:** Use seed rate of 1.6 – 2 Kg/acre.
   - **Seed Treatment:** To protect crop from long smut disease, before sowing do seed treatment with Ceresin 0.2% or Emission 1 gm/kg of seeds. After chemical treatment, use seeds for sowing.

5. **Fertilizer:**
   - Urea: 52 Kg/acre
   - Single Super Phosphate: 125 Kg/acre
   - Muratic of Potash: 23 Kg/acre
   - Nitrogen: 24 Kg/acre
   - Phosphorous: 20 Kg/acre
   - Potash: 14 Kg/acre

6. **Harvesting:**
   Plants begin yielding with the aid of using 4-6 months after transplantation. Harvesting is executed on the c program language period of 60-70 days. Sickles are used for harvesting. The harvesting begin in May and leads to January month. With the assist of sickle, grass is reduce at 1015 cm above from the floor stage for harvesting.

7. **Seed Collection:**
   Lemongrass saved for seed motive isn't always reduce as yield of seeds from vegetation subjected to everyday harvest could be very low. Generally, the plant vegetation at some stage in November/December in plains and mature seeds are gathered at some stage in January / February. A wholesome plant offers 10 to twenty g of seeds. The entire inflorescence is reduce and dried with inside the solar and seeds are gathered through thrashing in opposition to the ground or beating with sticks. Fresh seeds are advocated to be used in elevating a plantation because the seeds lose viability past six months of storage. [19]

**Extraction Methods**

1. **Soxhlet extraction technique:**
   Soxhlet extraction strategies contain stable/liquid touch for disposing of one or extra chemical substances from stable substances with the aid of using dissolution in liquid reflux. In a traditional Soxhlet extractor, the stable cloth is positioned into the thimble of
the extractor. It is regularly crammed up with the extracting liquid section with the aid of using condensing the vapours from the distillation flask. When the solvent receives to a specific level, a siphon pulls the thimble contents into the distillation flask, accordingly sporting the extracts into the majority liquid. The technique is sustained for the selected touch time, and is replicated. Moreover, has stated that many business programs require mathematical fashions for layout and powerful structures control. Models are simplified mathematical representations of structures at a specific factor in time and meant to sell information of the actual device. Therefore, technique modelling includes concerning collectively the houses of a device which might be motivated with the aid of using the technique. The final results is a hard and fast of mathematical equations that is the technique version. The technique version accommodates a hard and fast of mathematical formulations or equations that allow us to be expecting a chemical technique's dynamics. Sometimes, to optimizer maximize technique running variables, engineers can't pick the great running variables to be able to reduce running charges or maximize the income of a chemical technique plant. In a scenario like this, the technique version and suitable monetary statistics are used to investigate the triumphing scenario and decide the maximum worthwhile technique conditions. It is worth to word that mathematical fashions are beneficial in growing scale-up strategies from laboratory scale as much as pilot plant scale after which business scale-up permitting opportunity techniques to assess the choice of the technique variable conditions. In modelling with Microsoft Excel, extraordinary trend lines, together with linear, polynomial (quadratic and cubic), exponential, logarithmic, and electricity regression fashions, may be obtained.

**Soxhlet Extraction Process of Lemongrass Oil**

The test become finished in line with the technique defined by the use of 500 ml Shiniu GG-17 Soxhlet extractor. 100g of 0.5cm particle length lemongrass samples had been measured the use of weighing balance. The weighed pattern become placed into an extractor thimble, and 300ml of ethanol had been added into the flask. The heating mantle become set at a pre-decided temperature of 78°C in line with the solvent's boiling point. The test become performed thinking about the running variables, as said below:

A. The impact of particle (strong material) length on oil yield become achieved the use of 300ml of various solvents and 100g of particle sizes - 0.5, 1.0, 1.5, 2.0, and 2.5cm of lemongrass pattern for 60 mins. The outcomes had been recorded accordingly.

B. The impact of touch time on yield become achieved the use of 300ml of various solvents and 100g of 0.5cm particle length lemongrass pattern. Five one-of-a-kind touch instances of 60 mins durations had been used to examine the impact of touch time on yield. The outcomes has been recorded accordingly.

C. The impact of the quantity of solvent on oil yield become finished the use of 100g of 0.5cm particle length lemongrass pattern in 100ml, 150ml, 200ml, 250ml, and 300ml of solvent. [20]
2. Steam Distillation

The machine for steam distillation of lemongrass oil includes distillation stills, condenser and collector. The distillation nevertheless has an ability to maintain 11.5 kg of plant cloth consistent with consignment. Steam is produced through heating water in first nevertheless. 150g of lemon grass (chopped or UN chopped) is stuffed in second nevertheless and its lid is outfitted firmly, in order that oil and vapour do not no longer leak out. Steam is injected with second nevertheless with the assist of linking tube from the primary nevertheless. The upcoming steam contains away the oil from the plant cloth i.e. lemon grass and each oil in addition to steam by skip to the condenser thru vapours line, in which those vapours are condensed; oil and water are eliminated with inside the collector. Oil being lighter floats on pinnacle of the water. The aggregate of oil and water changed into divided with inside the setting apart funnel. The setting apart funnel is thus saved for twenty-four hours house time, and then water changed into indifferent and discarded from backside while the oil changed into accumulated in a separate beaker. The oil consequently received is lemon grass oil having 80-85% crucial content material and a few risky terpenes [10].

Solvent Extraction

60g of the dry pattern of lemongrass have been weighed from the sliced lemongrass pattern and located in a 500mL smooth flat backside flask. 300mL of n-hexane solvent have been poured into the 500mL flask and stopped. The flask and content material have been allowed to face for 72hrs; this changed into performed to extract all of the oil content material with inside the lemongrass and for entire extraction. After which the extract changed into decanted into every other 500mL beaker. 200mL of ethanol have been brought to extract the vital oil due to the fact that vital oil is soluble in Ethanol. The combination changed into then transferred to 500mL isolating funnel and separated through a procedure referred to as liquid-liquid separation procedure. The content material of the isolating funnel changed into allowed to return back to equilibrium, which separated into layers (relying on their exclusive density). The decrease Ethanol extract and the top Hexane layer have been gathered into separate 250mL beaker and have been located in a water tub at 78C. This changed into performed to dispose of the Ethanol leaving best the herbal vital oil. The yield of oil changed into decided through weighing the extract on an digital weighing balance. The distinction among the very last weight of the beaker with extract and the preliminary weight of the empty beaker gave the burden of vital oil 10mL of lemon grass vital oil extract have been measured and located in a beaker containing 5mL of alcohol. 5mL of the fixatives have been brought to the combination to enhance the sturdiness of the perfume. The answer changed into shaken and poured right into a bottle. [10]
3. Hydro distillation Method

Materials

Plant samples

Description:
1. Heater
2. Liebig condenser
3. Connector three way
4. Separating funnel
5. The stand
6. Clamp holder
7. Distiller
8. Thermometer

Partially dried lemongrass leaves supply yield better crucial oils than clean lemongrass leaves, hence, as soon as collected, the leaves might be dried at 70 °C for five h and saved in a moisture-unfastened environment. Regarding the scale of the material, preceding research indicated that the smaller the scale of the material, the better the yield of the product, as a result the scale of lemongrass leaves on this have a look at turned into investigated.

Reagents
- Anhydrous sodium sulphate (Na2SO4), Deionized water, etc.

Procedure
- Microwave-assisted hydro distillation the lemongrass oil extraction manner became done in a home microwave oven linked to the Clevenger equipment for MAHD operation. Experimental installation for the extraction degree is depicted. The microwave-assisted hydro distillation have been performed at water to uncooked cloth ratio of 1:1, 1:2, 1:3, 1:4, and 1:5 (g/mL) at 30, 60, 90, a hundred and twenty and a hundred and fifty min and working microwave strength of a hundred and fifty, 300, 450, six hundred and 750 W. The flask containing a hundred g of lemongrass (Cymbopogon citratus) and deionized water became located with inside the microwave oven cavity. For series of extracted crucial oils, a Clevenger equipment became set at the top, outdoor the oven. [4]

Hydro distillation
- In the MAHD process, a hundred g of in part dried lemongrass leaves have been located right into a thousand mL quantity flask linked immediately to the Clevenger equipment and heated with Heating Mantle User Manual heater Experimental installation for the extraction level is illustrated. The HD approach introduced four hundred mL of deionized water together with pattern material. Both strategies have been achieved on the equal length of 360 min. [4]

Bioactive Compounds Present in Lemon Grass and its Oil
- A vast array of ethno pharmacological packages of lemon grass exist today. Its fitness restorative ability can be ascribed to the numerous secondary metabolites it produces. Analysis of the grass confirmed the presence of fats, proteins, carbohydrates, fibre, minerals and numerous different bioactive compounds these may be grouped beneath neath specific training like alkaloids, terpenoids, flavonoids, phenols, saponins and tannins. Reports have additionally showed the presence of anthraquinones, steroids, phlobotannins, and cardiac glycosides in lemon grass.
Citral:
Formula: C10H16O
Boiling point: 225 °C
Molar mass: 152.24 g/mol
Citral-handled companies confirmed a dose-established discount in frame weight gain. They extensively had decrease fasting glucose levels, advanced glucose tolerance, decrease fasting plasma glucose, better metabolic rate, and smaller adipocytes after drug

**Purpose:** Citral is used with inside the synthesis of nutrition A, lycopene, ionone, and methyl ionone, to masks the odour of smoke. The herb Cymbopogon citratus has proven promising insecticidal and antifungal hobby towards garage pests.

**Toxicity:** Citral turned into unexpectedly metabolized and excreted as metabolites. Urine turned into the primary course of elimination. Acute toxicity of this chemical is low in rodents due to the fact the oral or dermal LD50 values have been greater than one thousand mg/kg. This chemical is tense to pores and skin and now no longer tense to eyes in rabbits [13]

Neral:
Formula: C10H16O
Boiling point: 225 °C
Molar mass: 152.24 g/mol
Neral is an enal this is 3,7-dimethyloctanal with unsaturation at positions C-2 and C-6. It has been remoted the important oils of plant species like lemon. It has a position as an apoptosis inducer and a plant metabolite. It is an Enal and a monoterpenoid. Neral have a lemon heady fragrance, however, neral has a milder, and sweeter lemon odour. These compounds are used for my part or collectively relying upon the favoured heady fragrance or taste due to the fact that they're utilized in perfumes, sweet or even gentle drinks. Neral are examples of cis/trans isomeric alcohol molecules located in important oils. [14]

Nerol:
Formula: C10H18O
Molar mass: 154.25 g/mol
**Boiling point:** 224 to 225 °C (435 to 437 °F; 497 to 498 K) Nerol is the (2Z)-stereoisomer of 3, 7-dimethylocta-2, 6-dien-1-ol. It has been remoted from the critical oils from vegetation like lemon grass. Nerol is a monoterpenoid alcohol discovered in lots of critical oils inclusive of lemongrass and hops. It turned into at the beginning remoted from neroli oil, subsequently its name. This colourless liquid is utilized in perfumery. Like geraniol, nerol has a candy rose smell however it's miles taken into consideration to be fresher. Toxicity: Causes pores and skin irritation. Material can be disturbing to the mucous membranes and higher breathing tract. May be dangerous with the aid of using inhalation, ingestion, or pores and skin absorption [16]

Citronellal:
Formula: C10H18O
Molar mass: 154.25 g/mol
**Boiling point:** 208 °C
Chemical properties: Citronellal has insect repellent properties, and research shows high repellent effectiveness against mosquitoes.

Odour: Citronellal is a monoterpenoid, the principle thing of citronella oil which offers it its unique lemon aroma. Citronellal (C10H18O) is a mono terpenoid aldehyde, the principle thing with inside the aggregate of terpenoid chemical substances that provide citronella oil its unique lemon scent. It has a function as a metabolite and an antifungal agent. It is a monoterpenoid and an aldehyde [17]

Limonene:-
Formula: C10H16
Boiling point: 176 °C
Molar Mass: 136.24 g/mol
Odour Like citrus fruits and commonly used in food products Limonene is a colourless liquid aliphatic hydrocarbon classified as a cyclic monoterpene and is the major component of citrus peel oils. The isomer, commonly found in nature as the flavour of oranges, is used as a flavouring agent in the manufacture of food products. [18]

### Nutritional Content of Lemon Grass:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Nutritional Component</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Carbohydrate</td>
<td>55.00%</td>
</tr>
<tr>
<td>2.</td>
<td>Crude Fat</td>
<td>5.10%</td>
</tr>
<tr>
<td>3.</td>
<td>Crude Protein</td>
<td>4.56%</td>
</tr>
<tr>
<td>4.</td>
<td>Crude Fibre</td>
<td>9.28%</td>
</tr>
<tr>
<td>5.</td>
<td>Energy</td>
<td>360.55 cal/100g</td>
</tr>
</tbody>
</table>

Table 1: Nutritional Content of Lemon Grass

### Mineral Content of Lemon Grass:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Mineral</th>
<th>Quantity (mg/100gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Na</td>
<td>54.8</td>
</tr>
<tr>
<td>2.</td>
<td>K</td>
<td>59.5</td>
</tr>
<tr>
<td>3.</td>
<td>Ca</td>
<td>39.5</td>
</tr>
<tr>
<td>4.</td>
<td>Mg</td>
<td>70</td>
</tr>
<tr>
<td>5.</td>
<td>Fe</td>
<td>0.024</td>
</tr>
<tr>
<td>6.</td>
<td>Mn</td>
<td>0.952</td>
</tr>
<tr>
<td>7.</td>
<td>Zn</td>
<td>121</td>
</tr>
<tr>
<td>8.</td>
<td>P</td>
<td>89.3</td>
</tr>
<tr>
<td>9.</td>
<td>Phytate</td>
<td>11860</td>
</tr>
</tbody>
</table>

Table 2: Mineral Content of Lemon Grass
Bioactive Component of Lemon Grass Oil:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Chemical Constituent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Citral</td>
</tr>
<tr>
<td>2.</td>
<td>Brunel</td>
</tr>
<tr>
<td>3.</td>
<td>α-terpineol</td>
</tr>
<tr>
<td>4.</td>
<td>β-Miocene</td>
</tr>
<tr>
<td>5.</td>
<td>β-O-Cimene</td>
</tr>
<tr>
<td>6.</td>
<td>Allo-o-cimene</td>
</tr>
<tr>
<td>7.</td>
<td>α-Pinene oxide</td>
</tr>
<tr>
<td>8.</td>
<td>Myrcenol</td>
</tr>
<tr>
<td>9.</td>
<td>t-Muurolool</td>
</tr>
<tr>
<td>10.</td>
<td>Linalool</td>
</tr>
<tr>
<td>11.</td>
<td>1-Octyn-3-ol trans-</td>
</tr>
<tr>
<td>12.</td>
<td>Chrysanthemal</td>
</tr>
<tr>
<td>13.</td>
<td>-Undecyne 3-carvomenthenone</td>
</tr>
<tr>
<td>14.</td>
<td>Citronellal</td>
</tr>
</tbody>
</table>

Table 3: Bioactive Component of Lemon Grass Oil [9]

Properties:
1. Antioxidant activity
   The antioxidant interest of C. citratus vital oil is because of the synergistic impact of all its parts. The antioxidant homes of lemongrass vital oil had been studied through many researchers, alenough there are a few discrepancies among the results, likely because of the exclusive geographical foundation of the plant, exclusive extraction methods, and method used to assess its antioxidant interest. The antioxidant homes of lemongrass vital oils are attributed to the presence of terpenoid and phenolic compounds which can also additionally display their redox homes using exclusive feasible mechanisms, like: hydrogen donation, loose radical scavenging interest, transition metallic chelating interest, and/or singlet oxygen quenching potential. Antioxidants can scavenge loose radicals and retard lipid oxidation in meals products, that is the principle motive of meals nice deterioration. Plants and their ingredients (vital oil, flavonoids, etc.) are taken into consideration to be purposeful meals if unique fitness blessings are attained through their consumption. These blessings consist of broadly speaking preventive and shielding however now and again healing homes in opposition to one or greater diseases, generally the so-referred to as civilization diseases (exclusive styles of cancer, cardiovascular and neurodegenerative diseases). The vital oil acquired from Cymbopogon citratus is a great purposeful meals ingredient. [3]

2. Anti-Inflammatory activity
   Traditionally, lemongrass is likewise acknowledged for analgesic and anti-inflammatory homes, but simplest few research were finished to confirm those consequences of lemongrass oil. Only recently, some studies companies have undertaken research to research anti-inflammatory homes of lemongrass crucial oil and its essential constituent central. Lemongrass carries central, an anti-inflammatory compound. According to a take a look at on animals, oral lemongrass crucial oil confirmed effective anti-inflammatory capabilities on mice with carrageenan-caused paw edema. The oil additionally established anti-inflammatory consequences whilst implemented topically on mice with ear edema. Flavonoids from lemongrass—Cymbopogon citratus. Leaves infusion, a typically ate up beverage for the remedy of inflammatory-associated conditions, Luteolin O-, C- and O, C-glycosides had been remoted and recognized via way of means of nuclear magnetic resonance, being the
cassiaoccentalin B shape absolutely characterised for the primary time in lemongrass. The anti-inflammatory pastime of luteolin and its glycosides turned into evaluated in lipopolysaccharide-inspired macrophages. Luteolin glycosides established much less cytotoxicity than luteolin itself. Although glycosylation decreases luteolin anti-inflammatory homes, being better to C-glycosylation, an inhibitory impact on inflammatory mediator production (nitric oxide and IL-1β) turned into confirmed for the luteolin 7-Oβglucopyranoside, without cytotoxic consequences. Therefore, luteolin glycosides from lemongrass infusion are evidenced as a much less poisonous opportunity to modern anti-inflammatory pills with promising use in pharmaceutical and meals complement industries. Additionally, this paintings establishes shape–pastime relationships, which constitutes precious statistics with inside the layout of anti-inflammatory luteolin glycosides without toxicity. [11]

3. Mosquito repellent activity :-

Mosquito repellents are crucial equipment for prevention of dreadful illnesses in addition to painful mosquito bites. Lemongrass critical oil (Cymbopogon citratus) has been investigated for its repellent pastime towards mosquitoes respectively. Lemongrass oil exhibited a mean of 30 min safety time towards mosquitoes to cause them to far from the located area, All-out (5080%) safety time in assessment to the pastime of the pleasant regarded chemical insect repellent, N,N-diethyl-mtoluamide (DEET). Determining the effectiveness of lemon grass (Cymbopogon citratus) as mosquito repellent is the principle aim of the study. Specifically, it intends to use the extraction manner strategies to extract the critical oils of lemon grass. It may be concluded that lemon grass oil is promising herbal repellent because of its protection benefit over chemical repellents. [12]

4. Food Preservative Activity-

Essential oils are taken into consideration as herbal substituents of chemical preservatives, due to the fact that their use in meals is regarded as secure and herbal. Food merchandise containing crucial oils are prevalent through customers and additionally meet the needs for inexperienced processing. Among the diverse crucial oils, the oil of C. citratus has been recognized maximum promising for makes use of as a meals preservative because it famous a number of essential and novel bioactivities. In the beef industry, some of chemical components have already been used, however the customers developing subject approximately the protection of meals merchandise has contributed to the shift of the pursuits from artificial compounds to herbal ones. The antimicrobial and antioxidant pastime of lemongrass oil can restrain foodborne pathogens and spoilage organisms in opposition to their improvement and next deterioration of meat merchandise. The benefits of the sort of remedy of meat are that lemongrass crucial oil can be beneficial in extending shelf-existence of meat merchandise, maintaining meat quality, stopping financial loss, and offering the patron with meat merchandise containing extra suitable herbal components. The antimicrobial pastime of garlic and thyme oils turned into now no longer as robust as that of the lemongrass oil. Lemongrass oil at an awareness of 1.5% confirmed a massive effectiveness in reducing cardio plate count, coliform count, Enterio bacteriaceae count, and Staphylococci count. Although several research have indicated that lemon- grass crucial oil may also function a capability meals preservative, little is understood approximately its poisonous effects. Some reviews propose that its excessive ranges in meat merchandise may also have a negative effect at the gustatory and olfactory systems. On the opposite hand, lemongrass crucial oil utilized in small concentrations is taken into consideration secure for human consumption. Essential oils are taken into consideration as herbal substituents of chemical preservatives, due to the fact that their use in meals is regarded as secure and herbal. Food merchandise containing crucial oils are prevalent through customers and additionally meet the needs for inexperienced processing. Among the diverse crucial oils, the oil of C. citratus has been recognized maximum promising for makes use of as a meals preservative because it famous a number of essential and novel bioactivities. In the beef industry, some of chemical components have already been used, however the customers developing subject approximately the protection of meals merchandise has contributed to the shift of the pursuits from artificial compounds to herbal ones. The antimicrobial and antioxidant pastime of lemongrass oil can restrain foodborne pathogens and spoilage organisms in opposition to their improvement and next deterioration of meat merchandise. The benefits of the sort of remedy of meat are that lemongrass crucial oil can be beneficial in extending shelf-existence of meat merchandise, maintaining meat quality, stopping financial loss, and offering the patron with meat merchandise containing extra suitable herbal components. The antimicrobial pastime of garlic and thyme oils turned into now no longer as robust as that of the lemongrass oil. Lemongrass oil at an awareness of 1.5% confirmed a massive effectiveness in reducing cardio plate count, coliform count, Enterio bacteriaceae count, and Staphylococci count. Although several research have indicated that lemon- grass crucial oil may also function a capability meals preservative, little is understood approximately its poisonous effects. Some reviews propose that its excessive ranges in meat merchandise may also have a negative effect at the gustatory and olfactory systems. On the opposite hand, lemongrass crucial oil utilized in small concentrations is taken into consideration secure for human consumption.

5. Anxiolytic properties -

In order to explain its efficacy in curing tension associated conditions, researchers have investigated anxiolytic residences of lemongrass. Earlier investigations pronounced poor outcomes associated with anxiolytic residences of the decoctions crafted from lemon tea. However, current experimental outcomes discovered that decoctions and infusion (lemon grass tea) crafted from lemon grass truly showcase the capability to motive anxiolytic outcomes whilst they're fed to animals. The use of lemongrass extracts for remedy of illnesses of important worried system (CNS) in peoples medicine. However, there are unanimous reviews amongst researchers o the protection of lemongrass tea for home and different makes use of as opined with the aid of using peoples medicine .1986; United States[11]
6. General uses-
The critical factor of lemon grass is the antimicrobial motion of crucial oil with inside the vapour phase. In the preceding look at, Lemongrass oil anti-fungal interest turned into assessed via extraordinary antimicrobial exams in each stages (i.e. in vapour and liquid phase). This look at demonstrates that the antifungal motion of Lemongrass oil and the Lemongrass oil vapour at ultrastructural degree thru TEM and SEM. Plant-borne antibodies are very critical due to the fact their facet outcomes are much less pronounced. The improved recognition and unwanted facet outcomes of a few antibiotics of multidrug resistance in pathogenic microorganisms have aroused full-size hobby with inside the look for new natural antimicrobials tablets. Various species of the lemon grass were due to its medicinal homes and nice effect at the fitness, for example, digestive stimulus interest, antioxidant interest, antimicrobial motion, anti-inflammatory, hypolipidemic, anti-carcinogenic interest and antimitogenic outcomes. Lemongrass flavonoids–Cymbopogon citrates leaves infusions are of medicinal importance, commonly fed on drinks for remedy of the inflammatory conditions. The Luteolin–C, Luteolin–O and C, O glycosides that are absolutely defined with inside the lemongrass for first moment are separated and diagnosed through the nuclear magnetic resonance. In lipopolysaccharide inspired macrophages, the anti-inflammatory motion of the luteolin and its glycosides turned into evaluated. The cytotoxicity of luteoline glycosides turned into decrease than that of luteoline itself. Although luteolin's anti-inflammatory homes were reduced through glycosylation, being better than C-glycosylation, the cytotoxic impact of the 7-O-β-glucopyranoside luteolin turned into checked for an inhibitor impact at the manufacturing of inflammatory mediators there are much less poisonous outcomes for cutting-edge anti-inflammatory tablets with use with inside the meals and pharmaceutical industries at the luteolin glycosides of lemongrass infusion. Additionally, it turned into found, shape interest relationships, which establishes valued records with inside the layout of the anti-inflammatory luteolin glycosides without cyto-toxicity. Number of medicinal importance of lemongrass is known. Lemongrass oil consists of a huge variety of fitness characteristics, except getting used as a fragrant flavour. Lemon grass have sort of importance in extraordinary pharmaceutical industries for its anti-depressant, analgesic, antipyretic, bactericidal, antiseptic, carminative and astringent homes. Biologists propose that oil of lemon grass is used for the remedy of various illnesses e.g., toothaches and complications etc. Lemongrass is likewise used as an insect repellent and a diuretic agent for fever. Its pepper coaching turned into used for menstrual and nausea relief. [11]

Experimental Methodology
Soxhelt extraction procedure:-
**Apparatus:** Soxhelt extractor, porous thimble medium, beaker (50 ml), heating mantle, weighing balance, measuring cylinder, seizer, scale etc.
**Chemicals:** Water (300ml), Lemongrass (about 100 gm) etc.
**Procedure:**
Take some fresh leaves of lemongrass and wash them thoroughly. Put them in an incubator to dry.
Cut the leaves in between 0.5-1cm in length
100g of 0.5cm particle size lemongrass samples were measured using weighing balance.
The weighed sample was put into an extractor thimble.
300ml of ethanol were added into the flask.
The heating mantle was set at a pre-determined temperature of 78°C according to the solvent's boiling point.
Two phases are involved in the production of cream:
1) The oil phase
2) Water phase

**Table 4: Material used in Cream Formulation**

<table>
<thead>
<tr>
<th>Oil Phase</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petroleum Jelly</td>
<td>10(g)</td>
</tr>
<tr>
<td>Bees Wax</td>
<td>8(g)</td>
</tr>
<tr>
<td>Vitamin E Oil</td>
<td>10(ml)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water Phase</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distilled Water</td>
<td>25(ml)</td>
</tr>
<tr>
<td>Borax</td>
<td>0.5(ml)</td>
</tr>
</tbody>
</table>

Table shows the materials and quantities used for the production of the cream before incorporating the essential oil. For the oil phase, mineral oil or Vitamin E, beeswax, petroleum jelly were mixed together in a beaker as indicated in (Table) and preheated slowly in a water bath for about 3-5 minutes with continuous stirring for proper mixing. For the water phase, borax and distilled water were put into another beaker and also heated for about 3-5 minutes also with continuous stirring. Alternatively the distilled water was put in another beaker and heated for about 3-5 minutes also with continuous stirring.
water can also be heated till almost boiling and stirred in baking soda. The water phase was then slowly added to the oil phase and the mixture was continuous to ensure proper mixing using a hand blender. The oil turned white immediately to show that emulsification was achieved. Immediately the pan was placed in an ice water bath in the sink.

After cooling, the cream was then portioned into four covered cups and the active ingredient (essentials oil) incorporated at different concentrations ranging from 0.5 to 2 ml with occasionally mixing until completely cooled and homogenous. [6]

Evaluation Parameters
1. Lemongrass Oil
   1. Colour :- Green, Yellowish green
   2. Odour :- Fresh, Grassy, Lemony
   3. Boiling point :- 268°C
   4. pH :- 5.6 - 6.2
   5. Gravity :- 0.80 - 0.90
   6. Solubility:
      1. Soluble in water
      2. Soluble in alcohol
   7. GC-MS Analysis of essential oil[6]

Efficacy test of the Essential oil

Five experiment were carried out with four different concentration of the active ingredient and one control. Sample 1, 2, 3 & 4 contained 0.5, 1, 1.5 & 2 ml of active ingredient respectively. Sample 5 was taken as the control experiment i.e. had no incorporated material in it.

<table>
<thead>
<tr>
<th>Cream (gm)</th>
<th>Active Ingredient(ml)</th>
<th>Repellence</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>0.5</td>
<td>Repelled mosquitoes between 1-2 hrs.</td>
</tr>
<tr>
<td>50</td>
<td>1</td>
<td>Repelled mosquitoes between 3-5 hrs.</td>
</tr>
<tr>
<td>50</td>
<td>1.5</td>
<td>Repelled mosquitoes between 5-6 hrs.</td>
</tr>
<tr>
<td>50</td>
<td>2</td>
<td>Bite was not noticed until 7 hrs.</td>
</tr>
<tr>
<td>50</td>
<td>Control</td>
<td>Bite was felt immediately</td>
</tr>
</tbody>
</table>

Table 5: Efficacy Test

Marketed preparations

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Marketed product</th>
<th>Formulation type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Terracacia</td>
<td>Massage oil</td>
</tr>
<tr>
<td>2</td>
<td>Ryllzessentials</td>
<td>Essential oil</td>
</tr>
<tr>
<td>3</td>
<td>Re-Fresh</td>
<td>Floor cleaner</td>
</tr>
<tr>
<td>4</td>
<td>Win greens</td>
<td>Green Tea</td>
</tr>
<tr>
<td>5</td>
<td>Re-Fresh</td>
<td>Bathing Soap</td>
</tr>
<tr>
<td>6</td>
<td>Rosemoore</td>
<td>Room Freshener</td>
</tr>
<tr>
<td>7</td>
<td>Panchami</td>
<td>Incense Stick</td>
</tr>
</tbody>
</table>
**Table 6: Marketed preparation**

**Result:**
From the experimental result, it was clearly confirmed that the essential oil in Lemongrass oil extract repels mosquito different concentrations. 0.5 ml concentration of mosquito repellent cream shows an activity up to 1 to 2 hours after application, 1 ml concentration of mosquito repellent cream shows an activity up to 3 to 5 hours after application, also 1.5 ml concentration of mosquito repellent cream shows an activity up to 6 hours after application, 2.0 ml was found to be most effective & concentration of mosquito repellent cream shows an activity up to 8 hours after application. It is clear that from the efficacy test (table 5) active ingredient in the Lemongrass oil showed a significant measure of repellence as well as toxicity to the mosquitoes.

**Conclusion:**
Lemongrass is easily available herb, that have many properties like antioxidant, anti-inflammatory, analgesic, preservative, anti-inflammatory, antimicrobial, mosquito repellent, anti-diabetic etc. There is the necessity to produce non-toxic, safe and biodegradable formulation. It is observe that the other mosquito repellent preparation like coil, fast card paper, liquid produces visible and nonvisible smoke that create difficulty in breathing as well as this smoke is hazardous for health of human and small children. Hence it is concluded that, our mosquito repellent cream is more effective & it is nontoxic to human health. This cream dose not have any side effects.

**REFERENCE:**
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