



“LEMONGRASS: “A COMPREHENSIVE REVIEW OF IDENTIFICATION, AUTHENTICATION, EXTRACTION, EVALUATION, AND STANDARDIZATION METHOD.”

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Abstract

Lemongrass essential oils are natural compounds with diverse biological activities, making them valuable in food, cosmetics, and pharmaceuticals. Their therapeutic potential is attributed to the presence of terpenoids and phenylpropanoid molecules. Plants, including lemongrass, have been used for centuries as therapeutic agents due to their nutritional and non-nutritional components, such as phytochemicals, flavonoids, and polyphenolics. Lemongrass powder and essential oil have been shown to promote gut health by exhibiting antimicrobial, anti-inflammatory, and antioxidant properties, enhancing nutrient absorption. This review highlights the phytochemical, pharmacological, and therapeutic potential of lemongrass, exploring its uses and benefits.

Key Words: Phytochemical constituent, pharmacological action, application, extraction, phytochemical screening, standardization, TLC.

Introduction

Lemon grass The tall, fragrant perennial grass *Cymbopogon citratus* has highly tufted fibrous roots and rhizomes. It has dense clusters of course, green, slightly leathery leaves on short underground stems with ringed segments (Carlin et al., 1985). Originally from India, the plant is grown in other tropical and subtropical nations.(2) Phytonutrients are compounds found naturally in plants that have been shown to have potent and specialized disease-preventing properties. Both essential and non-essential phytonutrients contribute to a particular physiological function With explanations of timer metabolic and physical processes, associated products, and biomarkers, they are referred to as bioactive food mechanisms. However, consumer knowledge and the link between nutrition and illnesses will determine the future need for nutraceuticals. (3) A number of bioactive substances found in lemon grass give it therapeutic properties. There is a lot of data supporting its ethnopharmacological uses. According to the WHO, almost two-thirds of people in developing nations view herbal medicine as an important component of the healthcare system.(4)

1.Plant profile

Plant:- lemon grass

Synonyms:-lemon grass stalk, andropogon citratus

Common name

Brazil: Capim-Santo and Capim-Cidrao

Egypt: Lemon grass

English: Squinant, citronella, and lemongrass

Hindi: Verveine, Sera

Italian:-Cimbopogone

Malaysia:-Sakumau,

Mexico: Limon Zacate

Sewdish:-Citrongrass

Thailand: Ta-khrai

Turkish: No Limon

USA:-Citronella,(6)

Parts used:- leaves and whole plan

Taxonomical classification

Kingdom: Plantae

Division: Magnoliophyta

Class: Liliopsida

Order: Poales

Family: Poaceae

Genus: Cymbopogon Spreng

Species: citratus(4)

Botanical description

Perennia lemon grass is a monocotyledonous grass that can reach heights of six feet and widths of four feet. It has long, slender, drooping, bright green leaves that are three feet long and 1.3 to 2.5 cm wide, and it grows in clusters. Simple leaves with full margins Grow on spiken, rowers. Its long inflorescence is between 30 and 60 centimeters long. Cymbopogo is the name given to this fragrant grass by its floral arrangement. One common inhabitant of Southeast Asia is Cymbopogoncitratus.(4)



Fig 1: lemon grass



Fig 2: lemon grass leaves

Physical-chemical characteristic:

The color is yellow.
The aroma is lemon-scented.
Gravity specific: 0.872–0.897
Index of refraction: 1.4830-1.4890
Rotation of the optics: -3 to +1
Value of carbonyl as citral: At least 75%
The fresh oil dissolves with 70% alcohol.
90% alcohol insoluble (5)

Phytochemical composition:-

The chemical makeup of *Cymbopogon Citratus* essential oil varies depending on where it comes from, however compounds like alcohols, ketones, esters, hydrocarbon terpenes, and mostly aldehydes have always been registered. Citral makes up the majority of the essential oil (0.2–0.5%) found in West Indian lemon grass oil. Trans isomer geranial (40–62%) predominates over cis isomer neral (25–38%) in citral, a mixture of two stereoisomeric monoterpene aldehydes.(7)

Chemical characteristics

L Citral: The citral component of lemongrass oil is responsible for the oil's distinctive lemony aroma. The unique scent of lemon is largely due to the essential oil citral, which is created by mixing the isomers geranial and neral.

L Geraniol: Another crucial ingredient in lemongrass oil that helps create that distinctive scent is geraniol.

L Citronellal: Lemongrass oil contains the terpenoid chemical citronellal. It is in charge of giving the oil its distinctive lemon scent.

Geranyl acetate: One of the chemical components that gives the oil its floral and sweet scent and flavor is geranyl acetate. It contributes to these characteristics as well.

L Limonene: This terpene, which is very prevalent, is primarily responsible for the zesty scent of lemongrass oil.

L Myrcene: Myrcene is present in many different plant species, including lemongrass. Aromas that resemble fruit or dirt could be present.

Terpinolene: Terpinolene is the terpene that is responsible for the woody and piney fragrances that the oil possesses.

L Linalool: Lemongrass oil includes trace amounts of linalool, a terpene alcohol with a floral aroma. Lemongrass oil contains it.

L Pinene: This likely constituent of lemongrass oil is pinene, which resembles pine tree scent.

L. Caryophyllene: This particular Sesquiterpene is what gives the oil its cozy, woody scent.(7)

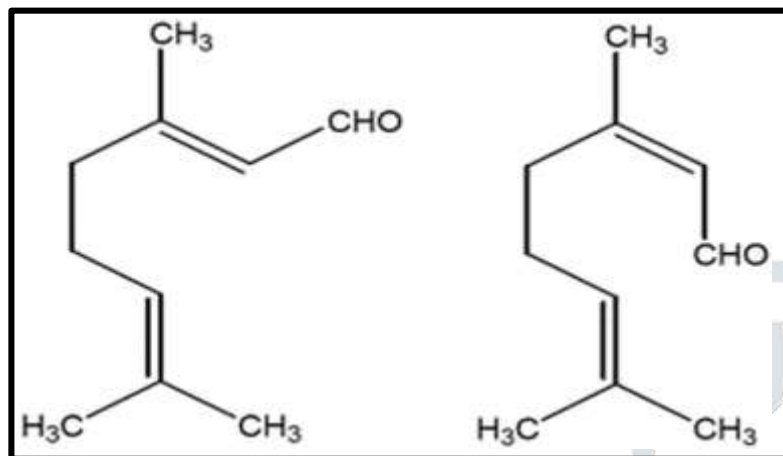


Fig 3 :structure of citral

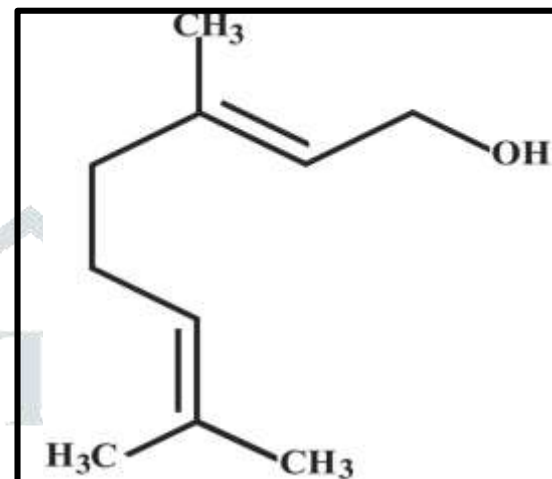


Fig 4 : structure of

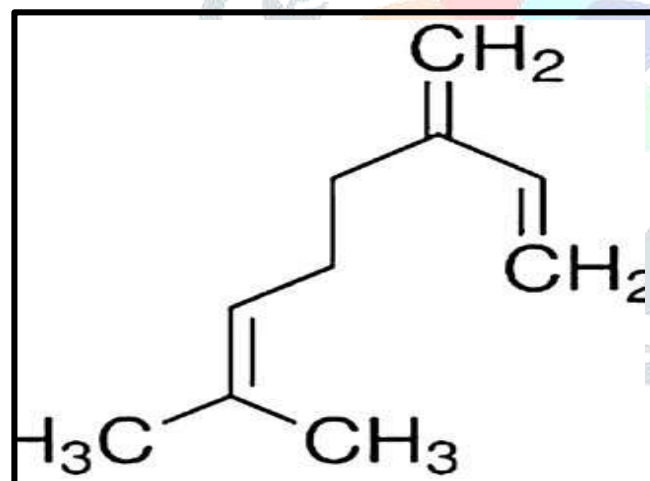


Fig 5 : Structure of

Applications and uses

Citronella and its bioactive constituents have long been used in traditional medicine in many countries. This is mainly because it has a number of therapeutic qualities, such as analgesic, antifungal, antibacterial, and anti-inflammatory effects. (7)

Cosmetics: A variety of soap, detergent, and cosmetic formulations commonly contain lemongrass oil as an ingredient. Additionally, it promotes muscle toning and helps the blood circulate regularly. Lemongrass is a long-lasting, non-irritating deodorant that has no discernible adverse effects when diluted appropriately, making it a cost-effective and eco-friendly option.(7)

Pharmaceutical and therapeutic effect: Lemongrass oil is used in addition to other remedies to treat flu, headaches, fevers, stomachaches, and muscle pains and pulls. Apart from the aforementioned health advantages, studies have demonstrated that lemongrass oil possesses antibacterial and antifungal properties against a range of pathogenic organisms, which makes it advantageous for the pharmaceutical sector. Lemongrass oil, which comes from *Cymbopogon citratus*, has been proposed as a possible treatment for a number of illnesses, including vascular disease, coughs, constipation, malaria, headaches, leprosy, elephantiasis, ophthalmia, pneumonia, influenza, and gingivitis. (7)

Meals and beverages: Lemongrass oil is used to flavor meals. Lemongrass oil has been used to flavor meat and meat products, baked items, tea leaves, alcoholic beverages, and confections. The purpose of lemongrass oil is to protect goods against storage fungi by effectively combatting post-harvest fungus toxins. (7)

Applications in industry: Deodorant, bug and mosquito repellent cream, candles, polish, waxes, insecticides, and antifungal cream are just a few of the many goods that include lemongrass oil and are marketed to customers as having a nice scent.(7)

Uses in agriculture: Although lemongrass oil has several uses in a variety of industries, its most common use has been in the agricultural sector. It has been demonstrated that certain lemongrass species' oils are used in the production of bactericides and germicides. Furthermore, it has been shown that lemongrass oil contains fungicidal, nematocidal, and insecticidal properties. Additionally, it's possible that lemongrass essential oil has insecticidal properties against other insects.(7)

Pharmacological action of lemon grass oil:-

Properties of Essential Oils

Essential oils, such as those derived from *Cymbopogon* and *Citronella*, have various properties that make them useful for different applications.(7)

Antibacterial Activity

The antibacterial action of Cymbopogon essential oil is the basis for its use in preserving raw and processed foods. For example, citronella oil has been shown to extend the shelf life of dried fish products by an additional week when used at a concentration of 1% (v/v) and stored at 4°C.(7)

Antifungal Activity

Essential oils also exhibit antifungal activity, which can help combat fungal skin infections caused by dermatophytid fungi and yeasts, such as Candida albicans. This is particularly important for immunocompromised patients who are more susceptible to these types of infections.(7)

Anti-Inflammatory Properties

Lemon grass essential oil has been shown to have anti-inflammatory properties, which can help reduce inflammation and edema. Studies have demonstrated that a hot water extract of dried lemon grass leaves can elicit a robust anti-inflammatory response in rats.(7)

Antiviral Properties

Some essential oils, including Cymbopogon nardus, have been found to possess antiviral properties, inhibiting the replication of viruses by at least 50%. These oils may be useful in preventing the spread of viral infections.(7)

Mosquito Repellent

Citronella essential oil has been shown to be effective as a mosquito repellent, providing a mean safety time of 30 minutes against mosquito bites. This makes it a useful natural alternative to chemical insect repellents like DEET.(7)

Anticonvulsant Properties

Essential oils may also have anticonvulsant properties, which can help combat central nervous system disorders such as epilepsy, depression, and anxiety. Further research is needed to fully understand the potential benefits of essential oils for neurological conditions.(7)

2. Method of extraction

1. Methods of Steam Distillation:

Fill a lighted round-bottom flask with 250 milliliters of distilled water and 150 grams of fresh lemongrass sample. There is a rubber cap on the flask. Attach the heat and condenser. 0°C water Steam is ensured by condensation through the condenser in the countercurrent. When water Lemongrass essential oil begins to boil when the temperature hits 100°C. When lemongrass is heated, water vapor is combined with the leaves to extract the essential oil. Through the steam and condenser used ice cubes to condense into a liquid. Allow for cooling and volatilize don't use essential oils. The condensate is Direct collection should be done in a 500 ml beaker before being poured into the separatory funnel. This creates two layers: one for water and one for oil. Separate faucet to release the water, open the funnel. Additionally, the oil Gather right away 100ml bottle with a cork To stop essential oils from evaporating, the bottle is tightly sealed, and oil is collected. Weigh the amount of oil that was produced.(8)



Fig 6 :steam distillation

2.Method of Solvent Extraction:

Weigh 150 grams of dried lemongrass, extract it from the sliced lemongrass, and place it in a clean flask with a flat bottom. A flask containing 500 milliliters of n-hexane solvent was filled. To extract all of the oil components in the lemongrass, the flask and its contents are left to stand for 36 hours. A second 1-liter beaker is then filled with the extract. To extract essential oils, 200 milliliters of ethanol are added. The oil is soluble in ethanol due to its essential nature. Next, combine the mixture. Using a procedure known as liquid/liquid separation, move to a 500 ml separatory funnel separation. Content that is separated the funnel is separated into two layers based on their varying densities and allowed to reach equilibrium. Place the top hexane and lower ethanol extract in two different 250 ml beakers and set them in a water bath set at 78°C. By doing this, the ethanol is eliminated, leaving just natural essential

oils. Weighing the extract on an electronic scale determines the amount of oil produced. Check the balance. The weight of the empty beaker yields the essential oil, which is the difference between the final and initial weights of the beaker holding the extract.(8)



Fig 7 : solvent extraction

3.Hydrodistillation Methods:

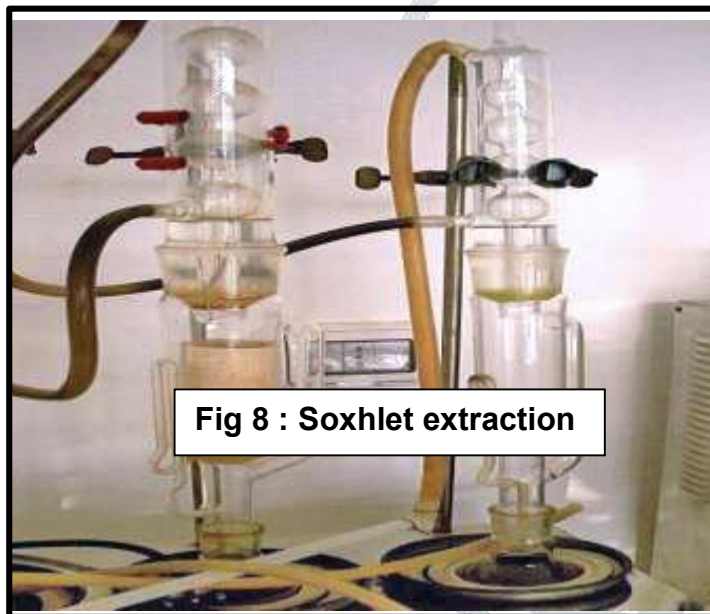
Fill a round-bottomed flask with 140g of fresh lemongrass and 500ml of distilled water. The flask is connected to the condenser and heated. It also has a rubber stopper. Water can be heated by allowing it to flow countercurrently through the condenser. Permit water to pass through the condenser in the other direction. The essential oil and water vapor were combined and extracted from the leaves once the temperature had reached the proper level. The condenser was the skilled oil-water overhead product. Condensation caused the vapors to separate. To prevent volatilization, use ice cubes to chill. A separatory funnel was used to separate the condensate after it had been collected in a beaker. Gather the oil in the container right away, use a stopper, and seal it tightly.(8)

4.Maceration

This process entails macerating, or soaking, the plant material sample in a solvent. Filtration and extract concentration follow. By using a very cold solvent, this approach lowers the likelihood of breakdown. However, it has the drawback of taking longer and using more solvent.(3)

5.Extraction of Soxhlet

Soxhlet extraction is a widely used method for extracting nutraceuticals, but it has disadvantages of its own, including the requirement for a large amount of solvent and the drawn-out process, which can take several hours to weeks (Kaur, 2016). Luque de-Castro and García-Ayuso (1998) and Castro and Priego-Capote (2010) state that the Soxhlet extraction procedure entails inserting the sample solid material containing the desired compound into the main chamber of the Soxhlet extractor after loading a thimble made of thick filter paper into it, as illustrated. The Soxhlet extractor is placed on top of a flask that has been filled with the extraction solvent. The Soxhlet is then connected to a condenser. Heating the solvent causes reflux. Following a distillation ascent The Solvent vapor enters the receiving chamber, which contains the solid thimble, after rising a distillation arm. The condenser ensures that any solvent vapor will cool and return to the chamber that contains the solid material. The compartment containing the solid material progressively fills



with the heated solvent. Some of the desired chemical will then dissolve in the heated solvent. When the Soxhlet chamber is almost full, a siphon side arm automatically empties it, letting the solvent back to the distillation flask. This cycle may be allowed to repeat many times over the course of hours. This cycle may be allowed to repeat many times over the period of hours or days. (6)

6.Extraction of Supercritical Fluids

Supercritical fluid extraction (SFE) uses supercritical fluid (CO₂) as a solvent to separate one component (extractant) from another (plant matrix) (Kaur, 2016). CO₂ is one of the most often used supercritical fluids in this extraction method. In addition

to being faster and more efficient than traditional solvent extraction, supercritical fluid solvents are also easier to remove. When pressure is lowered to allow the solvent to escape from the extracted analytes, recovery is typically achieved. This procedure is a standard example of supercritical fluid extraction (SFE). CO₂ is utilized as a solvent in this process. Because of these advantageous characteristics of CO₂, the resulting essential oils have organoleptic characteristics that are very similar to those of the plant from which they were extracted. CO₂ is cheap, safe, and widely available.(6)

Phytochemical screening

MATERIALS AND METHODS

Collection and Preparation of sample

After removing any adhesive impurities with running water, the plant leaves were let to air dry at room temperature. After that, it is sliced, allowed to air dry, and then crushed using a mortar and pestle. Hexane, ethyl acetate, and ethanol were used as solvents to extract a sample from 50 grams of dried powdered *Cymbopogon citrates* leaves that were placed in a different round-bottom flask. For seventy-two hours, 200 milliliters of the solvent combination are used for the extraction. The extract is gathered and saved for additional examination at the conclusion of the extraction process. (10)

Phytochemical screening

i)Test for alkaloids

Wagner's test:

The presence of alkaloids is indicated by the formation of a reddish-brown precipitate after a few drops of Wagner's reagent are added to around 10 milliliters of plant extract.(9)

Mayer's Reagent test:

Three grams of potassium iodide and 1.36 grams of mercuric chloride had to dissolve in 100 milliliters of water. A few drops of the reagent were introduced to a watch glass containing a small amount of each extract that had been diluted with hydrochloric acid. An alkaloid was present because a cream-colored precipitate formed. (10)

Hager's Reagent test:

It is a solution of picric acid and water. When this reagent was added to the test filtrate, a yellow precipitate that indicated the presence of alkaloids was created.(10)

ii)Test for Flavonoids

Shinoda Test:

Ten milliliters of extract and a pinch of magnesium turnings were mixed with one or two drops of strong hydrochloric acid. The appearance of a pink tint indicates the presence of flavonoids.(10)

Lead acetate test:

10 milliliters of extract were mixed with a few drops of a 10% lead acetate solution. The formation of a yellow precipitate indicates the presence of flavonoids.(10)

Fehling's Test:

One milliliter of each of Fehling's A and B solutions was mixed together, and the mixture was heated for one minute. An equivalent volume of the sample was added, and it was then boiled in a kettle of boiling water for five to ten minutes. Initially perceived as yellow, carbohydrates eventually take on a brick-red hue.(10)

iii)Test for Tannin:

Lead acetate test:

0.5 ml of a 1% lead acetate solution was added to 10 ml of extract, and the development of a precipitate signifies the presence of phenolic compounds and tannins. (10)

Ferric chloride test:

0.5 ml of 5% ferric chloride was added to 5 mg of extract. The emergence of a deep bluish-black hue signifies the existence of tannins. (10)

iv)Test for anthraquinone glycosides.

Boritrager's Test

Diluted sulphuric acid was applied to a 3ml sample, heated, and fluttered. Stir in a corresponding volume of chloroform to the filtrate. Ammonia was added after the organic layer had separated.

The ammoniacal layer turns pink, indicating the presence of glycosides.(10)

v)Test for Phenols :-

When five milliliters of extract are dissolved in half a milliliter of a 20% sulfuric acid solution and a few drops of aqueous sodium hydroxide solution are added, the extract becomes blue, indicating the presence of phenols.(9)

vi)Test for Amino Acids

Ninhydrin test:

Three milliliters of the crude sample were mixed with three drops of 5% ninhydrin, and the combination was then heated for ten minutes in a boiling water bath. Amino acids were identified by their bluish or purple.(9)

vii)Test for steroids:

Salkowski's test

After dissolving five milliliters of the extract in two milliliters of chloroform, an equivalent volume of concentrated sulfuric acid was poured along the test tube's sides. The presence of steroids is indicated by the bottom layer turning yellow with green fluorescence and the higher layer turning red. (9)

viii)Test for Saponins

Foam test:

In a graduated cylinder, 0.5 mg of extract was diluted with 20 ml of distilled water and vigorously shaken for 15 minutes. The presence of steroids and saponins was suggested by the formation of foam up to 1 cm in length. (9)

ix)Test for Glycosides :-

Glycoside test: an aqueous NaOH solution was added after 0.1 mg of extract had been dissolved in 1 ml of water. The presence of glycosides is indicated by the formation of a yellow hue.(9)

Standardization

Pharmacognostic Assessment

Assessment of Organoleptic

By examining the plant's color, odor, taste, size, form, morphology, and unique characteristics including texture, the organoleptic aspects were assessed. Fresh plant leaves were used to determine the stomatal number and stomatal index, which are components of quantitative microscopy.(11)

Histological and Microscopic Methods

Examining Transverse Sections

Water was used to boil the *Cymbopogon citratus* leaves until they were tender. The leaves were sliced into free-hand portions, placed on slides that had been cleaned with chloral hydrate, and then mounted in glycerin. Differential staining methods were used to discriminate between the lignified and cellulosic tissues. (11)

Photographic microscopy

Micrographs were used to support microscopic assessments of tissues. The Nikon Lab pot 2 Microscopic Unit was used to take pictures at various magnifications. Normal observations were conducted in a bright field. Polarized light was used to examine crystals,

starch grain, and lignified cells. These structures look brilliant against a dark backdrop when exposed to polarized light because of their birefringent properties. The scale bars denote the figures' magnifications.(11)

Microscopy using powder

A sample of powdered plant material on a slide was coated with a few drops of chloral hydrate solution. Heat slowly over a microbunsen with a glass slip. There was no vigorous boiling. The slide was looked at. under a microscope. A drop of glycerol solution was added after the cleaning operation was finished to stop the material from crystallizing when it cooled.(11)

Analysis with physicochemistry

Alcohol (90% ethanol), water-soluble extractive values, total ash, acid-insoluble ash, and loss upon drying of the powdered medication were all determined by physicochemical analysis.(11)

Chromatography

Material and method

Plant material

Associate Professor Uthai Sotanaphun discovered the dried herbal raw materials, which were gathered from the Thai region of Nakhon Pathom in 2016 and included kaffir lime leaf, galangal rhizome, and lemon grass rhizome. The voucher specimens (US-01 through US-03) are kept at Silpakorn University's Herbarium, which is part of the Department of Pharmacognosy in Thailand. They were all cut into little pieces. The 1:2:1 mixture of lemon grass, galangal, and kaffir lime leaf was extracted twice using ten times the weight of water at 100°C for two hours, and it was then dried using a rotary evaporator. As previously mentioned, an aqueous extract of every herb was also made independently. The dried aqueous extracts of the mixture and each herb were reconstituted in water at a concentration of 100 mg mL⁻¹ and 30 mg mL⁻¹, respectively, for TLC analyses.(12)

Thin Layer Chromatography:

TLC silica gel 60 F254S aluminum plates (12 cm x 10 cm, 0.25 mm thick, Merck, Germany) were used for the TLC analysis. Using a TLC sampler Linomat 5 (Camag, Switzerland), 15 µL of each aqueous solution were put as a 10 mm band onto a TLC plate. In a TLC chamber, the plate was developed to a distance of 10 cm. In the opposite trough of the twin chamber, four distinct mobile phases were used: ethyl acetate-formic acid-acetic acid-water (100:11:11:26, v/v/v/v), n-hexane-ethyl acetate-acetic acid (5:3:1, v/v/v) preconditioning with toluene-ethyl acetate (93:7, v/v), tolueneacetone-formic acid (7:3:0.1, v/v/v/v/v), and HCl. After that, the plate was let to air dry at room temperature. Each TLC plate was examined under UV light at 254 nm, 366 nm, and white light after being derivatized with anisaldehyde reagent (0.5 mL p-anisaldehyde, 1 mL H₂SO₄ in 50 mL AcOH) and heated for five minutes at 110 C. Every TLC image was captured with a CAMAG TLC visualizer. All of the solvents and chemicals used were of the quality of analytical reagents. The aqueous extract sample solutions were found to be stable on TLC plates during analysis. The TLC techniques'

robustness was examined by making small changes to the compositions of the mobile phases. Every assay was carried out in triplicate to assess the TLC method's reproducibility. For the purpose of assessing robustness and reproducibility, R_f values for each of the principal bands seen in each TLC examination were noted. R_f values of the same band should not differ from plate to plate by more than 0.02 as a suitable acceptance criterion.(12)

Conclusion

Asia, Africa, and portions of the Americas are among the tropical places where *Cymbopogon citrates* is grown. Essential oils are used in the perfumery and cosmetics industries as a fragrance and flavor-enhancing ingredient. This substance's many medicinal qualities, such as its antifungal, anti-inflammatory, antiseptic, antispasmodic, antibacterial, analgesic, antitussive, anti-rheumatic, hypotensive, and anticonvulsant actions, are used in traditional medicine. Numerous volatile compounds found in lemongrass essential oils have uses in pharmacological, cosmetic, agricultural, culinary, and aromatherapy industries, among others. There are several ways to extract the essential oils from lemongrass.(7) The use of *Citrus* essential oil in the food chain is gaining popularity. Numerous phytoconstituents, including terpenes, terpenoids, esters, and phenolic compounds, are present in the oil and are in charge of various biological actions, chiefly antifungal and antibacterial ones. (13)

Aknowledgement

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We are deeply appreciative of our guide's unwavering direction, insightful recommendations, and assistance during the writing of this evaluation on the identification, extraction, and assessment of lemongrass (*Cymbopogon citratus*).

We would especially like to thank the Department of Pharmacognosy's teaching and non-teaching staff for their helpful collaboration.

Result and discussion

Extractive yield

The maceration technique was used to extract the powdered leaves of *Cymbopogon citratus* using ethanol. The following formula was used to determine the extract's percentage yield following solvent evaporation:

Yield Percentage = $\frac{\text{Weight of Extract Obtained}}{\text{The dried powder's weight}} \times 100$

Yield Percentage = $\frac{\text{Weight of Dried Powder}}{\text{Weight of the Obtained Extract}} \times 100$

Weight of the Obtained Extract × 100

Solvent Utilized Dried Powder Weight (g) Extract Weight (g) Yield Percentage

50 g of ethanol 7.8 g 15.6%

A large variety of polar phytoconstituents were present, as evidenced by the excellent yield of the ethanolic extract.

Organoleptic Evaluation

Parameter	Observation
Color	Dark green to brown
Odor	Characteristic lemon-like aroma
Taste	Bitter and aromatic
Consistency	Sticky semi-solid mass

Table 1 : organoleptic evaluation**Phytochemical Screening**

Preliminary qualitative phytochemical tests were carried out on the ethanolic extract of *Cymbopogon citratus*.

Phytochemical Test	Result
Alkaloids	+
Flavonoids	+
Phenolic compounds	+
Tannins	+
Saponins	+
Terpenoids	+
Glycosides	+
Steroids	—

Table 2 : phytochemical

Physical Characteristics of Extract

Parameter	Observation
Appearance	Viscous extract
Solubility	Soluble in ethanol and methanol
Moisture content	4.2 %
pH (1% solution)	6.8

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