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PROJECT REPORT ON EXTRACTION AND PHARMACEUTICAL APPLICATIONS OF LEMONGRASS

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ABSTRACT

Lemon grass is an aromatic medicinal grass belonging to the genus Cymbopogon. It is prevalent in the semi-temperate and tropical regions of Asian, American and African continents. The prefix lemon owes to its typical lemon like odour, due to presence of citral a cyclic monoterpene. A strong lemon fragrance, a predominant feature of this grass, is due to the high citral content in its oil. The redolence of the oil enables its use in soaps, detergents and perfumes. It also finds an application in the pharmaceutical industry. Apart from nutrients such as fats, proteins, fiber and minerals, it also contains various bioactive compounds which may be grouped into alkaloids, terpenoids, flavonoids, phenols, saponins and tannins. Anti-oxidant, anti-inflammatory, anti-bacterial, anti-obesity, antinociceptive, anxiolytic and antihypertensive evidences of lemongrass tea were clearly elucidated to support initial pharmacological claims Lemongrass is considered a quintessential food and feed additive at the industrial level, since there are no issues with residue or toxins. Lemongrass powder and essential oils are used to modulate the gut ecosystem by generating anti-microbial, anti-inflammatory, and antioxidant responses, increasing the optimum nutrient absorption in the gut system. The health restorative capacity of lemon grass may be ascribed to the diverse secondary metabolites it produces. This review attempts to give an overall description of lemon grass, highlighting its medicinal properties which make it a potent herb for pharmacognostic applications.

KEYWORDS: Lemon grass, Extraction, Identification, Properties and Isolation.

INTRODUCTION

lemon grass, popularly known as citronella grass is a member of the Poaceae family and belongs to the genus Cymbopogon. The genus Cymbopogon constitutes of approximately 140 species that show widespread growth across the semi-temperate and tropical regions of Asian, American and African continents. Australia and Europe are home to only a few species of lemon grass. Lemon grass is a tall plant having enormous striped leaves with an uneven edge. It is known for its smoky, sweet, herbaceous and lemony fragrance. The members of the Cymbopogon genus produce volatile oils and thus are also known as aromatic grasses.

The redolence of the oil enables its use in soaps, detergents, etc. As a good source of citral, it finds an application in the perfumery as well as food industries. It is also the starting material for the manufacture of ionone's, which produce Vitamin A. Lemon grass contains several bioactive compounds that impart medicinal value to it. Considerable evidence is available for its ethnopharmacological applications.

Apart from an overall description of lemon grass, this review article also highlights its medicinal properties that make it a potent herb for pharmacognostic applications.

In recent years huge number of studies have been carried out, acclaimed medicinal properties emphasized on different pharmacological effects of the lemongrass such as: anti-amebic, antibacterial, antidiarrheal, anti-filarial, antifungal, anti- inflammatory, antimalarial, antimycobacterial, anti- nociceptive, anti-protozoan, ascaricidal, free radical scavengers and antioxidant, hypo-cholesterolemic, hypoglycemic, hypolipidemic, larvicidal activity, neurobehavioral effect 8, anticancer, anti- hypertensive, insects repellent and insecticide 5, antigout. Lemongrass is a folk remedy for coughs, elephantiasis, flu, gingivitis, headache, leprosy, malaria, ophthalmic, pneumonia and vascular disorders. Studies have shown that the lemon grass has antibacterial and antifungal properties. Mixed with pepper, it's a home therapy for menstrual troubles and nausea. The lemon grass is a good cleanser that helps to detoxify the liver, pancreas, kidney, bladder and the digestive tract. It cuts down uric acid, cholesterol, excess fats and other toxins in the body while stimulating digestion, blood circulation, and lactation; it also alleviates indigestion and gastroenteritis. It is said that lemon grass also helps improve the skin by reducing acne and pimples and acts as a muscle and tissue tone.

Kingdom: Plantae

Division: Magnoliophyta

Class: Liliopsida

Order: Poales

Family: Poaceae

Genus: Cymbopogon

Species: citrates

Extraction

Essential oils are extracted from flowers, herbs, trees and various other plant materials. These oils contain a mixture of chemical compounds. These oils contain a mixture of chemical compounds. Terpenes associated with aldehydes, alcohols and ketones form the major chemical component of such essential oils. Apart from being used to manufacture of perfumes, soaps, cosmetics and detergent, citronella oil also finds an application in the pharmaceutical industry. Terpenes associated with aldehydes, alcohols and ketones form the major chemical component of such essential oils. Apart from being used to manufacture of perfumes, soaps, cosmetics and detergent, citronella oil also finds an application in the pharmaceutical industry. The extraction of this essential oil is classified as clean technology. Lemon grass contains 1-2% of essential oil on a dry weight basis. Lemon grass oil is also known as citronella oil. Steam and hydro distillation are the conventional methods of its extraction. These procedures are however time consuming. An innovative Microwave Assisted Hydrodistillation (MAHD) not only reduces the extraction time but also retains the quality of oil. The benefits of microwave radiation aided oil extraction technique over hydrodistillation have also been reported. Pressurized liquid extraction using nitrogen gas, is a novel technique and was found to yield better quality of oil in comparison to Soxhlet extraction and hydrodistillation methods. Supercritical extraction of citronella oil with CO_2 under high pressure has also been investigated.

Steam Distillation

According to Hesham *et al.* (2016), steam distillation is widespread method for isolating essential oils commercially. About 80 to 90% of vital plant constituents are obtained using steam distillation method. The technique is good for fresh plant materials that have a high boiling point most especially roots and seeds. In this method, the plant matrix(solid) is placed in the perforated grid, steam is released from steam boiler to the extraction still(pot) passing

through the plant matrix(solid) and oil is removed from the plant matrix by diffusion process and comes out with steam to the condenser, then to the separation unit. Generally, Clevenger steam distillation apparatus in Figure 2 is used for recovering small quantities of solid plant material. Advantages of this method includes easy control of steam quality and quantity at any instance, low risk of thermal degradation as temperature is generally not above 100°C. Its only disadvantage is that of high level of technicality, repairs and maintenance.

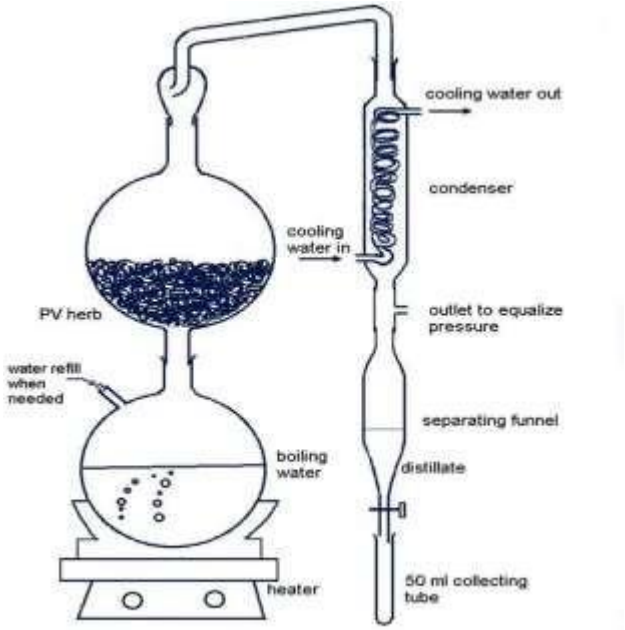

Figure 1: Steam distillation apparatus (Mak and Walsh, 2021).

Water (Hydro) Distillation

Li *et al.* (2014) have stated that, hydro-distillation differs from steam distillation. Hydro-distillation is used to bring out aromatic plants oil via boiling water. This method has some disadvantages which include slow distillation process resulting into long distillation time thereby leading to consuming more energy that makes the process uneconomical, extraction of herbs (leaves) is not always complete, Long stay of plant materials in hot water may cause changes in composition, The plant raw material very close to bottom walls of the pot have direct contact with the heat source, therefore, there is likelihood of plant material getting burned resulting to bad odour to the oil. Figure 3 is a typical schematic hydro-distillation apparatus.

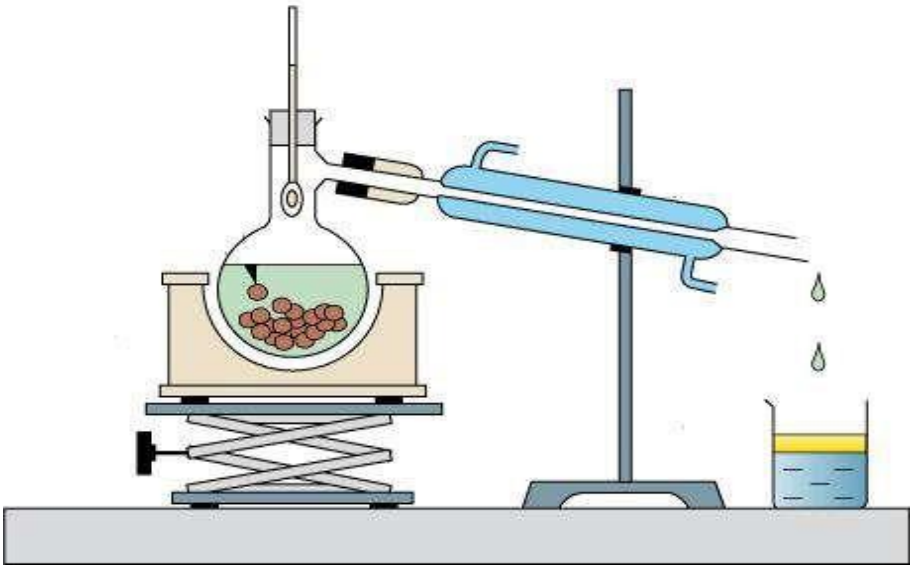

Figure 2: Hydro-distillation apparatus (Hesham *et al.*, 2016)

Effleurage

Effleurage method of extraction has its origin from Grasse, a southern part of France where it was first used for extraction of flower oils. In this method, the glass plate is covered with thin-layer of purified fixed oil or fat upon which fresh flowers are spread. In effleurage process, the volatile oil is recovered in a fatty base. In this method, the essential oil is usually separated from fatty compounds by adding alcohol. After a time, the alcohol evaporates leaving the essential oils. Effleurage is highly labor- intensive method of extraction (Trease and Evans, 1978).

Maceration

This method involves soaking (macerating) the sample plant material in solvent, then after a while, filtering and concentration of the extract will take place. This method uses very cold solvent that reduces the chances of decomposition. But, it has adisadvantage of taking longer time as well consuming a lot of solvent (Joy *et al.*, 2006).

Solvent extraction

In solvent- extraction, raw materials are placed in a glass vessel and soaked in either of petroleum ether, hexane or benzene etc. Inthis method, as soon as extraction is completed, the solids are separated from the liquid mixture. The latter is heated so that the more readily vaporizing (diffusing) component of the oil can be evaporated, then subsequently condensed. Solvent extraction uses very little heat as a result; it is advantageous to obtained oils with whole fragrances that would have been otherwise destroyed by excess heat and steam. One

disadvantages associated with the solvent-extraction method is that of solvent residues which often contaminate the product thereby resulting to side effects that makes the use of essential oil undesirable for skin applications but may still be used in cosmetics and household products (Ndou, 1986). Reports have shown solvent extraction method has a higher yield than steam distillation and effleurage method of obtaining essential oil of lemongrass (Suryawanshi *et al.*, 2016; Shetty *et al.*, 2017)

Soxhlet Extraction

Soxhlet extraction is one of commonly used method for extraction of nutraceuticals, but has its own limitations which include use of a large quantity of solvent and the process can be quite time consuming, taking from a few hours up to several weeks (Kaur, 2016). Castro and Priego-Capote, 2010; Luque de-Castro and García-Ayuso, 1998 explained Soxhlet extraction that, sample solid material containing desired compound is placed inside a thimble made from thick filter paper that is loaded into the main chamber of the Soxhlet extractor as depicted in Figure 4. The Soxhlet extractor is placed onto a flask containing the extraction solvent. The Soxhlet is then connected to a condenser. The solvent is heated to reflux. The solvent vapor travels up a distillation arm and floods into the receiving chamber housing the thimble of solid. The condenser ensures that any solvent vapor cools and drips back down into the chamber housing the solid material. The chamber containing the solid material slowly fills with warm solvent. Some of the desired compound will then dissolve in the warm solvent. When the Soxhlet chamber is almost full, the chamber is automatically emptied by a siphon side arm, with the solvent running back down to the distillation flask. This cycle may be allowed to repeat many times over hours or days.

Supercritical Fluids Extraction

Supercritical fluid extraction (SFE) involves separating one component(extractant) from another (plant matrix) using supercritical fluid(CO_2) as solvent (Kaur, 2016). One of the most common supercritical fluids employed in this extraction technique is CO_2. Supercritical extraction is quicker and more effective than ordinary solvent extraction; besides, supercritical fluid solvents are more easily removed. Recovery is usually accomplished when pressure is reduced to release the solvent from the extracted analytes. Figure 5 is a typical Supercritical fluid extraction (SFE) process. In this method, CO_2 is used as solvent. These desirable properties of CO_2 makes the essential oils that are produced have organoleptic properties closely resembling those of the plant from which the oil was extracted**.** CO_2 is

inexpensive, safe and abundant. oil was extracted**.**

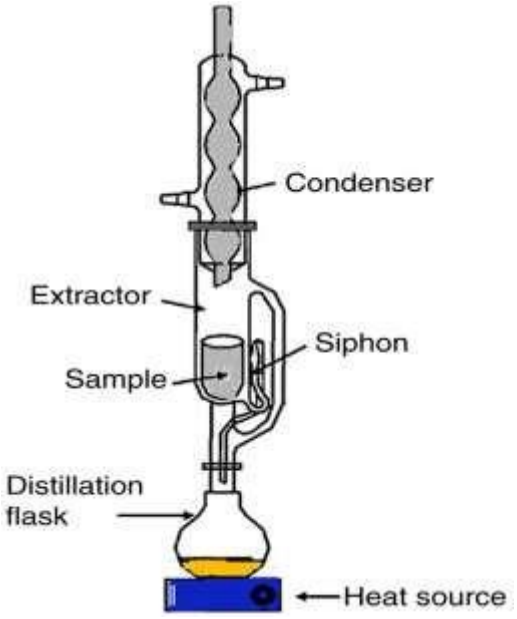

Figure 3: Soxhlet Extractor Apparatus (Kaur, 2016).

Phytochemical composition

The herb *Cymbopogon*, a member of the Poaceae family, is also referred to as lemon-grass. Lemongrass *(Cymbopogon citratus)* is commonly known for its higher citral contents. Early or postponned harvesting of the lemongrass affected essential oils and also affect the citral contents. Factors like temperature, luminous intensity, soil humidity, fertilizer and maturity affected the essential oils and citral components. During maturity, the plant originates from vegetative to the reproductive stage. Overall, the yield of essential oils is highly interrelated with yield of the plant biomass. Increased quality essential oils with greater citral contents (75%) are determined from being harvested at a certain stage by the ratio of the young leaves to older leaves. Lemongrass essential oils are normally obtained by different methods like solvent, accelerated solvent dense CO_2 and the Soxhlet, solidphase matrix, and the super-critical fluid extraction techniques. Due to its commercially valuable essential oils, lemongrass is frequently used in food technology, pharmaceuticals, and traditional treatments. The terpenes, alcohols, ketones, and esters present, as well as the essential oil of lemongrass, differ according to its topographical origin, which affects its chemical makeup. The essential oil that is extracted from lemongrass is mostly found in the leaves of the plant, which are also a great source of it Phenolic compounds are a diverse class of plant secondary metabolites, including phenolic acids, flavonoids, stilbenes, lignans, coumarins, curcuminoids, and other polyphenols. Flavonoids are the most

abundant phenolic constituents, containing more than ten thousand compounds.

Up to 5% dry weight of essential oils, primary citral with a distinctive lemonade scent, are present in the leaves. Due to the presence of citral, a cyclic monoterpene, the word "lemon" in its name refers to its distinctive lemon-like aroma. Numerous consumer products contain fragrances made using the oil of lemongrass contains 75-85% of aldehydes consisting largely of citral, linalool (1.34%), geraniol (5.00%), citronellol, nerol (2.20%), 1,8 cineole, citronellal (0.37%), linalyl acetate, geranyl acetate (1.95%), α-pinene (0.24%), limonene (2.42%), caryophyllene, β-pinene, β-thujene, myrcene (0.46%), β- ocimene (0.06%), terpenolene (0.05%), methyl heptanone (1.50%) and α-terpineol (0.24%). Likewise, the composition of essential oil of West Indian lemongrass oil Cympobogon citratus contains approximately α-pinene (0.13%), β-pinene, delta-3- catrene (0.16%), myrcene (12.75%), dipentene (0.23%), β-phellandrene (0.07%), β-cymene (0.2%), methyl heptanene (2.62%),citronellal (0.73%), β-elemene (1.33%), β-caryophyllene (0.18%), citronellyl acetate (0.96%), geranyl acetate (3.00%), citral b (0.18%), citral a (41.82%), geraniol (1.85%), elemol (1.2%) and β-caryophyllene oxide (0.61%) (Saleem et al, 2003a; Saleem et al, 2003b). And that of C. pendulus oil is reported to contain pinene (0.19%), camphene (0.01%), β- pinene (0.16%), car-3-ene (0.04%), myrcene (0.04%), dipentene (0.35%), phellandrene (0.3%), pcymene (0.36%), methyl heptanone (1.05%), citronellal(0.49%), linalool (3.07%), β-elemene (0.7%), β-caryophyllene (2.15%), citronellyl acetate (0.72%), geraniol acetate (3.58%), citral b (32.27%), citral a (43.29%), geraniol (2.6%), elemol (2.29%) and β-caryophyllene oxide (1.56%). Myrcene is an anti-bacterial and analgesic compound found in lemongrass, and citronellal, citronellol, and geraniol are its active ingredients. Citral, a volatile oil with a robust lemon aroma, is present in the essential oil. Citral is a mixture of two aldehydes and a stereoisomeric monoterpene; it is used to make perfumes and colored soaps, and synthesizes vitamin A. The geranial with trans isomer nature (40–62%) prevails over the neral with cis isomer nature (25–38%) in citral. Lemongrass has a long history of use in food and beverage recipes, folk medicine, and cosmetics. Due to its alluring scent, Lemongrass is utilized as a flavoring component in many non-food products, such as soaps, perfumes, candles, and insect repellents. The essential oil of this plant is considered one of the chief volatile oils. Essential oils, perfumes, and volatile plant byproducts have a significant advantage in both the perfume and folk medicine businesses. Many essential oils and the substances that make them up have pharmacological capabilities that act as anti-inflammatory, antioxidant, and anti-cancer agents. The most important physicochemical

properties of lemongrass oil usually considered includes specific gravity(SG), refractive index(RI), percentage of citral, freezing point, moisture content, acid value, ester value, carbonyl value and phenol content (Pushpakumari, 1987).

Uses

Various species of the lemon grass have been because of its medicinal properties and advantageous impact on the health, for example, digestive stimulus activity, antioxidant activity, antimicrobial action, anti inflammatory, hypolidemic, anti-carcinogenic activity and antimutagenic effects.

Essential oils are very variable in response to sources. Lemongrass oil includes a wide range of health characteristics, besides being used as an aromatic flavor. Lemon grass have variety of significance in different pharmaceutical industries for its anti-depressant, analgesic, antipyretic, bactericidal, anti-septic, carminative and astringent properties. Biologists suggest that oil of lemon grass is used for the treatment of different ailments e.g, toothaches and headaches etc. Lemongrass is also used as an insect repellent and a diuretic agent for fever.

It is also a good antiseptic and deodorizer. It is used to prepare foot baths and feet talc for sweaty smell feet. It may be used to treat the ringworm and tinea for any fungal treatments of the feet. It can occasionally trigger inflammation of the skin and also trigger other kinds of inflammation. Therefore, during pregnancy it is better to avoid application.

Due to its attractive fragrance, lemongrass oil is used as an additive ingredient in several products which include deodorant, mosquito and insect repellents cream, candles, polish, waxes, pesticides, anti-fungal cream and perfumes Lemon grass is an extraordinary herb used for both culinary and medicinal purposes over a period of years. Lemon grass is a green and white plant with a grassy blade and grows in hot tropical climates throughout the planet Lemon grass has been traditionally used to remediate a plethora of medical conditions. This is due to the broad spectrum of secondary metabolites that it produces.

It has been used to treat fever, cough, elephantiasis flu, leprosy, malaria and digestive problems among many other illnesses. The use of lemon grass in Ayurveda is still relevant today due to its therapeutic value (Figure 1).

Conventional medicine has a lot of adverse effects. inhalation of vapors of β-citronellol enhances the sympathetic nerve activity of the rats that leads to the increased activity in the

adipose tissue resulting in weight loss. In spite of numerous uses of lemongrass oil in various industries, it has been widely used also in agricultural sector.

The oils of certain species of lemongrass have been found application in germicide and bactericide production. It has been claimed that the oil can enhance the flavor of some fish, as well as to flavor wines, sauces, confections, spices, and tea leaves. It can be used fresh, powdered, or dried due to its aromatic, lemon-scented qualities.

Although the lemongrass pseudo stem is challenging to consume, it can be crumbled and added to dishes or grilling rubs. The oil glands which carry aromatic oils in the pseudo stem are released if it is bruised or added whole.]. Dried lemongrass leaves are widely used as a lemon-flavored component in herbal teas. In contrast to regular tea, lemongrass is a diuretic and does not alter the body's biochemistry. Commercial applications for the essential oil of the Cymbopogon genus include its use as an aroma for soap and an ingredient in perfume and palm arosa oil.

In the cosmetic industry, several lemongrass products with proprietary formulae combine glycerol, lemongrass, and lemon balm oil. It has been demonstrated that lemongrass essential oil deters insects, making it possible to use it as an insect-repellent lotion. The cosmetic industry benefits significantly from this oil's antioxidant properties, as it can be utilized to prevent several skin ailments caused by oxidative stress. Additionally, this substance can be utilized as an anti-aging cream, as oxidative stress is linked to degenerative disorders of chronic nature that accelerate the process of aging (Sara et al. 2006). In the past year, a thorough analysis of the bioactivities of lemongrass that are relevant to its possible aesthetic benefits has also been conducted.

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