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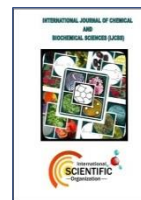
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Lemongrass: a review on its botany, properties, applications and active components

Mahouachi Wifek¹, Asma Saeed², Rafia Rehman² and Shafaq Nisar^{2*}

¹Laboratory of management and valorisation of forest resources, Institut National de la Recherche en Génie Rural, Eaux et Forêts (INRGREF)- University of Carthage, Ariana, Tunisia and ²Department of Chemistry, University of Agriculture, Faisalabad, Pakistan

Abstract

Lemon grass (*Cymbopogon citratus*), is a member of poaceae family. It is a medicinal plant with compounds capable of controlling pathogens and increasing herbal resistance to pathogenic diseases. Lemongrass is widely used in the herbal teas and other non-alcoholic beverages in baked food, and also in the confections. Essential oil from the lemongrass is commonly used as a fragrance in the perfumes and cosmetics, such as creams and soaps. Lemon grass essential oil is comprised of a high content of citral, which is used as a source for the production of beta carotene and vitamin A etc. Hence, due to the presence of various chemical constituents present in lemon grass oil, it uses in different pharmaceutical industries for its anti-depressant, analgesic, antipyretic, bactericidal, anti-septic, carminative and astringent properties.

Key words: Poaceae, Citral, Cosmetics, Vitamin A, Analgesic

Full length article *Corresponding Author, e-mail: shafaqnisar12@gmail.com, Tel: +923237628206

1. Introduction

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. *Cymbopogon flexuosus* is broadly utilized in preparation of soups, curries and teas. This herb contains calming character. Lemon grass (*Cymbopogon flexuosus*) is native sweet-smelling tall sedge. It is a member of the family Poaceae. It grows in numerous parts of the tropical and sub-tropical South East Asia and Africa. Lemon grass (*Cymbopogon citratus*), is a grass native to Pakistan, India and Sri Lanka [1]. In Pakistan, it is in Northern areas, Gilgit and Juglote cropping in seasons. In India Western Ghats (Kerala, Maharashtra), Karnataka and the Tamil Nadu states other than foot slopes of the Sikkim and Arunachal Pradesh [2]. *Cymbopogon citrates*, is generally known as Lemongrass is a tall perennial grass. It belongs to the genus *Cymbopogon* of aromatic grasses and contains essential oils with the fine lemon flavor. In Asia Lemongrass is widely used as essential component for health. In India it is use as sedatives for the central nervous system [3]. The *Cymbopogon* essential oils are characterized by the monoterpene constituents like limonene, citral, elemol, citronellal, 1,8 cineole, citronellol, linalool, geraniol, methylheptenone, b-carophyllene, geranylformate and geranyl acetic acid derivation. Chemical characterization of essential oils is generally done with the use of GC-MS [4-6].

Citral is one of the significant ingredients of the oil present in a few species of *Cymbopogon* with huge modern uses, for example, crude material for vitamin A, confectionery and perfumery [7]. It grows a bit of the tropics by tucking a group of lemongrasses into a pot or nursery bed. This herb brings the textural magnificence and development of a fancy grass to the nursery, alongside one extra feature: lemony leaves with a trace of ginger. It leaves the ground when warm nights arrive. It looks for new stalks to rise. Combine lemongrass with chile peppers, garlic and cilantro for the makings of Asian and Thai cooking. In cold regions, a stalk is digin late summer and spots it into a pot to develop inside through winter. *Cymbopogon citratus* a herb which is known throughout world as lemon grass is widely used as a source of medicines in tropical countries [8]. Plant leaves are utilized as tea and is generally used in Brazil as analgesic, antipyretic, spasmolytic, tranquilizer, anti-inflammatory and diuretic and. This plant contains 1–2% essential oil on a dry base. The chemical composition of the lemon brass oil (LGO) broadly different due to its genetic diversity, habitat and the agronomic treatment of this plant [2]. Lemon grass essential oil is comprised up of a high content of citral (geranial and neutral isomers), which is used as a source for the production of beta carotene and vitamin A etc. Antimicrobial action of LGO is used for various pathogenic fungi [9]. Lemon grass is a native

tropical Asia and now-a-days it grows worldwide. Because of its slight citrus flavor, dried and fresh leaves of the lemongrass are common ingredients of the Asian cuisine in curries, teas and soups, it also suitable for the poultry, seafood and fish. This herb is widely consumed as an aromatic herb Latin and African countries. In addition, its aerial components are widely utilized in folk medicine for the treatment of digestive disorders, diabetes, nervous disorder, inflammation and fever [10]. Functional lemongrass components have been recognized in recent years. A strong contribution to the antioxidant and anti-inflammatory characteristics of an important oil-free lemongrass infusion has been recognized as mono- and polymeric flavonoid, such as apigenin glycosides, luteolin and and proantho cyanidins [11]. Mono- and polymer flavonoids, such as luteolin and apigenin glycosides and proanthocyanidins, have been recognized which have contributed significantly to the antioxidant and anti-inflammatory characteristics of vital oil-free lemongrass infusions. The actions and the molecular mechanisms of purified phenolic compounds are responsible for the anti-inflammatory activity of lemon grass. Medicinal plants play an important role in the health societies. The recovery of the practices and knowledge associated with medicinal plant resources are part of an important strategy related to conservation of the biodiversity, findings of the new medicines, and for the bettering of quality of life of the rural communities. *Cymbopogon* (family: Poaceae) genus comprises of about 120 species. It grows in the sub-tropical and tropical regions of the world due to its wide uses in the cosmetics, food, pharmaceutical, agriculture and flavor industries. Large scale cultivation of *Cymbopogon* grasses occurs in the sub-tropics and tropics. Due to the presence of higher content of aldehyde *Cymbopogon citratus* possesses lemony odor. It has two geometric isomers, neral (citral-b) and geranial (citral a) [12]. Generally, without the other one isomer does not arise. Besides citral, the essential oils of the *Cymbopogon spp.* consists of smaller amount of geranyl acetate, geraniol and the monoterpene olefins, such as myrcene (in *C. citratus*) and limonene (in *C. flexuosus*) and. *Cymbopogon citratus* is generally used in the folk medicine for treatment of the gastrointestinal disturbances, and as analgesic, antispasmodic, antipyretic, anti-inflammatory, sedative and diuretic activity [13]. Extracts from *Cymbopogon citratus* leaves have demonstrated the antioxidant, antifungal and the antimicrobial action [12]. Consumers are increasingly aware and concerned about the use of synthetic chemicals in the food additives. Thus, food can be preserved with the natural additives have become more and more preservatives for encompassing the shelf life of various food products. Indeed, essential oils not only showed antimicrobial activity in vitro against several pathogens in the foodstuffs but also in the food systems [14]. Lemon grass is frequently used as a flavoring agent in

various food products. In addition to its attractive citric taste, lemongrass essential oils have demonstrated its powerful antimicrobial potential, thus being susceptible for incorporation into the food products. Though, food products still present some limitations. Its intense, persistent aroma greatly impacts the organoleptic characteristics and the consumer acceptance of food [15]. This presents toxicological effect at higher dose [16]. Thus, there is a need to lower the concentration of essential oil incorporated into the food products to avoid toxicological effects, consumer rejection, and to take into account the economic aspects [17].

2. History

Lemon grass, a perennial plant commonly grown in the sub-tropics and tropics, designates two different species, West Indian, *Cymbopogon citratus* and East Indian, *Cymbopogon flexuosus*. Various species of the lemon grass are native to the South East Asia, South Asia and Australia. That is why it is called as the tropical Asia East Indian lemon grass. (*Cymbopogon flexuosus*) also known as the Cochin or *Malabar grass* and is native to Sri Lanka, India, Thailand and Burma and for the associated West Indian lemon grass (*Cymbopogon citratus*). Both these species are today cultivated throughout [18]. In Philippines, Lemon grass was being distilled for export as early as 17th century. The first samples of closely related citernolla oil were displayed at world's fair at London crystal place in 1951. It is a favorite oil in India for many years and is known locally as "choomana polu" which refers to the plant red grass stem [19]. Indigenous Australians used citrus fruit to make a drink and use for washing of skin cuts and eyes [20]. The lemongrasses are commercially cultivated in the India, Guatemala, Paraguay, and the People's Republic of China, Sri Lanka, England and the other parts of Africa, Indochina, South America and Central America. The plants are grown in the dense clumps up to 2m in diameter and up to 1m long leaves. This genus is native to the South Asia, Australia and the Southeast Asia.

Lemongrass is widely used in the herbal teas and other non-alcoholic beverages in baked food, and also in the confections. Essential oil from the lemongrass is commonly used as a fragrance in the perfumes and cosmetics, such as creams and soaps. Citral, extracted from the oil of lemon grass, is used in flavoring of soft drinks, in scenting detergents and soaps, as a fragrance in the perfumes and cosmetics, and as a mask for disagreeable odors in various industrial products. Citral also used in the formation of ionones used in perfumery. Lemon grass a medicinal plant has been considered as an insect repellent and carminative. West Indian lemongrass is reported to have strong antimicrobial action. Essential oils of West Indian lemongrass are acts as a central nervous system depressant. Essential oils of East Indian lemongrass have strong antifungal action. The volatile oils also have some

mutagenic and pesticidal action. *Cymbopogon nardus* is a source of citronella oil. *Cymbopogon martinii* is reportedly toxic to the fungi. Lemongrass has been generally accepted as safe plant extract/essential oil for the human consumption. One of the most versatile plants is Lemongrass. It produces delicious herbal tea, which is often used in cooking as an efficient antibiotic and a near-impermeable barrier to weeds. Keep the outer leaves in a loop and prepare with meals for flavor. Before serving, be sure to remove it. Incredibly fast to become established and drought tolerant [21].

3. Location

The *Cymbopogon citratus* grows well in sunny warm, moist tropical conditions. In Kerala the general effects on plants are small over 30 °C, but the oil content is reduced seriously. Lemon grass is grown in a variety of soils [22]. Lemongrass blooms in a broad range of Sanskrit, from wealthy loam to bad lateritis. Calcareous and water logged ranges between 300-350 t/annum. *Citratus* is a tropical perennial plant which yields the Cochin oil of commerce. Lemon grass which grow in sandy soils have greater leaf oil yield and also citral content. When lemongrass grows in highly saline soils it gives greater oil yield [23].

4. Botany, Morphology, Ecology

Lemon grass is large, perennial sedge, which is a dense rhizome with dense leaf clusters. The leaf is erect, up to a height of 1.8 metres. Leaves are long, glaucous, green, which tapered upwards linear and along the margins; ligule (a part of leaf that is found at the junction of the blade and leaf sheath) very short; its sheaths are cylindrical, barren shoots widened at the base and tightly clasping at the bottom, others narrow and separating. It is a short day plant and produce plentiful flowering in South India. The inflorescence is approximately 1 meter long. Lemongrass is an aromatic plant belonging to the Gramineae family [12]. It possesses higher quality of essential oils and lower cost of production. It is a large, clumped, perennial grass that grows up to a height 1 m. The leaf blades are linear, conical at both ends and can expand to 50 cm in length and 1.5 cm in width [24]. The shape of leaf-sheath is tubular and it acts as a pseudo-stem. This plant generates flowers in mature growth phases [24].

5. Chemistry

Lemon grass (*Cymbopogon citratus*), is a member of poaceae family. It is a medicinal plant with compounds capable of controlling pathogens and increasing herbal resistance to pathogenic diseases. This aromatic plant is used in perfume production and is grown to produce essential oils for business purposes. Due to its good aroma, it is used for preparation of the colognes, deodorants and soaps in different pharmaceutical industry [25]. Its major components are citral monoterpenes (an isomeric mixture of the geranial and neral) and myrcene both of which have anti-bacterial and medicinal importance. The citral mono

terpenes show anti-fungal and anti-microbial action. These characteristics attracts the attention in the agronomy [25].

5.1. Chemical composition

Lemongrass (*Cymbopogon citratus*) is commonly known for its higher citral contents. Early or postponed 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 CO₂ and the Soxhlet, solidphase matrix, and the super-critical fluid extraction techniques. The advanced techniques, such as high performing Liquid chromatography in conjunction with the gas chromatography (HPLC-GC) are the preferred analysis technique due to the complexity of the essential oil components. HPLC is more effective for a broad class separation of a sample, which can be introduced into a GC for further higher separation

6. Post-Harvest Technology

Lemongrass generally flowers in the winter season. Subsequent harvests are done at intervals of 60-70 days. Three harvests are feasible in ordinary conditions during the first year and 3-4 in the subsequent years, depending on management practices that followed. The crops are harvested using the sickles, cut to 10 cm above the ground level, before being transported to the distilling plant, allowed to wilt in the grown fields. Plantation lasts on average for 3-4 years, depending on the soil and weather. Yield of essential oils varies according to the age of plant. The yield of essential oil is lower in the first year but in the second year it rises and reaches a peak in the third year; after this, the yield decreases. On an average, 25 to 30 tonnes of the fresh herbage are harvested per hectare per annum from 4 -6 cuttings, which yields about 80 kg of oil. Under irrigated conditions from newly bred varieties an oil yield of 100-150 kg/ha is obtained. Lemon grass contains on average 0.3% oil and thick stems are removed before distillation. Thick stems are devoid of oil [26].

7. General uses

The important aspect of lemon grass is the antimicrobial action of essential oil in the vapour phase (Lopez et al., 2005). In the previous study, LGO anti-fungal activity was assessed through different antimicrobial tests in both stages (i.e. in vapour and liquid phase). This study demonstrates that the antifungal action of LGO and the LGO vapour at ultrastructural level via TEM and SEM. Plant-borne antibodies are very important because their side effects are less pronounced. The increased popularity and

unwanted side effects of some antibiotics of multidrug resistance in pathogenic micro-organisms have aroused enormous interest in the search for new herbal antimicrobials drugs. 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, hypolipidemic, anti-carcinogenic activity and antimutagenic effects [20]. Essential oils are very variable in response to sources. Essential oils are obtained from various varieties of plants, including flowers, trees, grasses, shrubs, fruits and herbs. The oils collected are concentrated in various parts of the plant. Many essential oils are renowned for their antimicrobial action [27-28], but often the mechanism of action is not fully understandable. This mechanism may involve membrane disruption of lipophilic components. The hydrophobicity that allows them to split up in the fluids of bacterial cell membrane and mitochondria thus disrupting and make structures more permeable is a significant feature of the essential oils and their constituents [29]. Lemongrass flavonoids–*Cymbopogon citrates* leaves infusions are of medicinal significance, generally consumed beverages for treatment of the inflammatory conditions. The Luteolin-C, Luteolin-O and C,O-glycosides, which are completely described in the lemongrass for first moment, are separated and recognized by the nuclear magnetic resonance. In lipopolysaccharide stimulated macrophages, the anti-inflammatory action of the luteolin and its glycosides was evaluated. The cytotoxicity of luteoline glycosides was lower than that of luteoline itself. Although luteolin's anti-inflammatory properties have been decreased by glycosylation, being higher than C-glycosylation, the cytotoxic effect of the 7-O- β -glucopyranoside luteolin was checked for an inhibitor effect on the production of inflammatory mediators (nitric oxide and IL-1 β). There are less toxic effects for current antiinflammatory drugs with use in the food and pharmaceutical industries on the luteolin glycosides of lemongrass infusion. Additionally, it was found, structure activity relationships, which establishes valued information in the design of the antiinflammatory luteolin glycosides devoid of cytotoxicity [30]. Number of medicinal significance of lemongrass is known. 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. Its pepper preparation was used for menstrual and nausea relief. Lemon grass oil goes well with other essential oil like Coriander, Basil, Jasmine, Cedar Wood, Geranium, Lava

din, Tea tree and Lavender. 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 [31]. 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 [20].

8. Summary

Lemon grass (*Cymbopogon citratus*), is a member of poaceae family. It is a medicinal plant with compounds capable of controlling pathogens and increasing herbal resistance to pathogenic diseases. Lemongrass is widely used in the herbal teas and other non-alcoholic beverages in baked food, and also in the confections. Essential oil from the lemongrass is commonly used as a fragrance in the perfumes and cosmetics, such as creams and soaps. Lemon grass essential oil is comprised of a high content of citral, which is used as a source for the production of beta carotene and vitamin A etc. Hence, due to the presence of various chemical constituents present in lemon grass oil, it uses in different pharmaceutical industries for its anti-depressant, analgesic, antipyretic, bactericidal, anti-septic, carminative and astringent properties.

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