



Lemon Grass

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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. 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. A vast array of ethnopharmacological applications of lemon grass exist today. 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. 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, *Cymbopogon*, Citral, Bioactive compounds, Pharmacognostics.

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. Also known as 'Squinant' in English, lemon grass is known by various other colloquial names throughout the world. The members of the *Cymbopogon* genus produce volatile oils and thus are also known as aromatic grasses.^{1,2}

A strong lemon fragrance, a predominant feature of this grass, is due to the high citral content of its oil. 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.³

Lemon grass contains several bioactive compounds that impart medicinal value to it. Considerable evidence is available for its ethnopharmacological applications.⁴ According to the WHO, herbal medicine is considered an important part of the healthcare industry by more than two-thirds of the population in developing countries.⁵

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.

Taxonomical and Botanical Description

Lemon grass is a perennial monocotyledonous grass which can grow upto 6 feet in height and 4feet in width. It grows in clusters. It has long, slender, drooping bright

green leaves that measures from 1.3-2.5cm in width and 3feet in length. Leaves are simple with entire margins. Flowers grow on spikes. It has a lengthy inflorescence ranging from 30-60cm. The floral arrangement of this scented grass gives it the name '*Cymbopogon*'. *Cymbopogon citratus* is a common inhabitant of Southeast Asia.^{3,4,6} Taxonomic details of this herb are as follows:⁶

Kingdom : Plantae

Division : Magnoliophyta

Class : Liliopsida

Order : Poales

Family : Poaceae

Genus : *Cymbopogon*

Species : *citrates*

Extraction of Lemon Grass Oil

Essential oils are extracted from flowers, herbs, trees and various other plant materials. These oils contain a mixture of chemical compounds. Terpenes associated with aldehydes, alcohols and ketones form the major chemical component of such essential oils.⁷ 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.^{8,9} Lemon grass contains 1-2% of essential oil on a dry weight basis.¹⁰ 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.^{7,11} An innovative Microwave-Assisted Hydrodistillation (MAHD) not only reduces the extraction time but also retains the quality of oil.⁷ The benefits of microwave radiation aided oil extraction technique over



hydrodistillation have also been reported.^{12,13} 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.¹⁰ Supercritical extraction of citronella oil with CO₂ under high pressure has also been investigated.¹⁴

Bioactive Compounds Present in Lemon Grass and its Oil

A vast array of ethnopharmacological applications of lemon grass exist today. Its health restorative capacity may be ascribed to the diverse secondary metabolites it produces. Analysis of the grass showed the presence of fats, proteins, carbohydrates, fiber, minerals and several other bioactive compounds (Table 1-3). These can be grouped under different classes like alkaloids, terpenoids, flavanoids, phenols, saponins and tannins. Reports have also confirmed the presence of anthraquinones, steroids, phlobotannins, and cardiac glycosides in lemon grass.¹⁵⁻²⁰

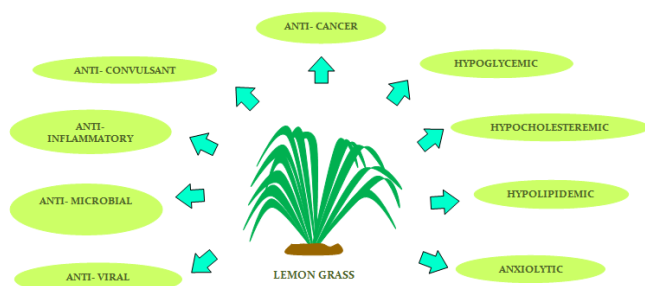


Figure 1: Activities shown by lemon grass that contribute to its therapeutic value

Table 1: Nutritional Content of Lemon grass

S. No.	Nutritional component	Quantity
1.	Carbohydrate	55.00 %
2.	Crude fat	5.10 %
3.	Crude protein	4.56 %
4.	Crude fiber	9.28 %
5.	Energy	360.55 al/100g

Table 2: Mineral Content of Lemon grass

S. No.	Mineral	Quantity (mg/100g)
1.	Na	54.8
2.	K	59.5
3.	Ca	39.5
4.	Mg	70
5.	Fe	0.024
6.	Mn	0.952
7.	Zn	121
8.	P	89.3
9.	Phytate	11860

Table 3: Bioactive components of Lemon grass oil

S. No	Chemical Constituent
1.	Citral
2.	Burneol
3.	α -terpineol
4.	β -Myrcene
5.	β -O-Cimene
6.	Allo- <i>o</i> -cimene
7.	α -Pinene oxide
8.	Myrcenol
9.	<i>t</i> -Muurolol
10.	Linalool
11.	1-Octyn-3-ol <i>trans</i> -
12.	Chrysanthamal
13.	3-Undecyne 3-carvomenthenone
14.	Citronellal
15.	Neral
16.	<i>trans</i> -(-)-Carveol
17.	Geranial
18.	Nerol
19.	Citronellol
20.	Methyl-n-nonyl-ketone
21.	Dextro-carvone
22.	Geranic-acid
23.	α -Bergamotene
24.	Isolongifolene-4-5-9-10-dehydro Levo- β -elemene
25.	γ -Muurolene
26.	α -Gurjunene
27.	α -Muurolene
28.	α -Amorphene β -Sesquiphellandrene
29.	α -Farnesene
30.	α -Elemol
31.	<i>d</i> -Cadinene
32.	Germacrene-D
33.	Valencene
34.	Viridiflorol
35.	α -Selinene
36.	Humulene
37.	α -Guaiene
38.	<i>t</i> -Cadinol
39.	β -Eudesmol
40.	(<i>E,E</i>)-Farnesal pimelyl dihydrazide
41.	Di-n-octylphthalate
42.	Geranyl-acetate

Medicinal Properties of Lemon Grass and its Oil

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. Therefore plant-based medicine has become a popular alternative for synthetic medicine. Thus, this herbaceous plant may find many applications in the pharmaceutical industry.²¹⁻²⁴

Indonesian Scientists have investigated and confirmed the ability of β -citronellol-the major component of "Sereh Wangi" (colloquial name for Lemon grass in Indonesia) oil, to bring about a reduction in weight of rats fed with a high fat diet. 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. The findings of this study were significant due to the fact that β -citronellol caused a reduction in body mass without affecting the concentration and activity of the liver enzymes.²⁵ Weight loss is only one of the few pros of citronella grass.

Maintenance of oral health is an important aspect of daily routine. Gingivitis and periodontitis are oral health conditions caused due to dental plaque. Many reports confirm that these dental caries are risk factors for ischemic stroke and cardiovascular disease. The antagonistic activity of lemon grass against the planktonic and biofilm forms of *Candida dubliniensis*, a common oral pathogen has been reported. Citronella grass may be used in formulating herbal drugs for oral healthcare.²⁶⁻²⁹

Medical conditions like hyperlipidemia, hypercholesteremia and hyperglycemia lead to metabolic disorders like obesity and diabetes mellitus. It has been reported that lemon grass is bestowed with hypolipidemic, hypocholesteremic and hypoglycemic properties. Consumption of plant extracts have shown to bring about a reduction in plasma cholesterol and very low density lipids, both of which are highly correlated with heart disease. Hypoglycemic condition in rats was achieved after 42 days of administration of 500mg/kg/day lemon grass extract. The mechanism of action is however not clear.³⁰⁻³² In addition to these benefits, several reports have confirmed the anti-inflammatory, anti-convulsant and anxiolytic effects of lemon grass extracts.^{33,34}

Additionally, the antagonistic activity of lemon grass towards different pathogenic bacteria, protozoa and fungi has also been reported.³⁵⁻⁴⁴ Leishmaniasis is severe disease that affects the global human population annually on a large scale. It has been reported that the promastigotes of *Leishmania infantum* undergo programmed cell death upon exposure to citral, a major constituent of lemon grass oil. Also, reports suggest the anti-proliferative effect of citronella oil on the anoxic amastigotes of *Leishmaniasp.*⁴⁵⁻⁴⁷ Lemon grass, may be foreseen as an anti-protozoan drug of the future. The ability of *Cymbopogon* species to inhibit the growth and aflatoxin production in *Aspergillus* sp. and in *Penicillium citrinum*, thereby reducing the deterioration of melon

seeds, has been reported.⁴⁸ It is also seen that the combination of silver nanoparticles and the oil have synergistic inhibitory action on growth of pathogens like - *Escherichia*, *Staphylococcus*, *Moraxella*, *Enterococcus* and *Candida* sp.⁴⁹ Citronella oil, also exhibits potent anti-fungal activity against *Candida* sp. and *Aspergillus niger* by showing inhibitory zones in the range of 35 to 90mm. Also, the oil shows similar effects to 50 mg/kg synthetic oral drug diclofenac when administered in mice suffering from carragennan induced edema. *In vivo* anti-inflammatory action of the oil is also evident when it is topically applied on croton oil induced edematous mice.⁵⁰ Lemon grass can be used in preparations of topical skin creams and in the manufacture of plant based oral drugs. Research on anti-microbial and anti-inflammatory activities of lemon grass, after its GC-MS analysis, has revealed its major constituents as limonene, nerol, geranial, geraniol and myrcene. Hence it is inferred that these compounds may be responsible for its microbicidal and anti-inflammatory effects. There is a lot of data that attests the anti-inflammatory effects of monoterpene aldehydes. Bioactive compounds such as citral, neral and geranial have been found to inhibit the production of IL-1 β , an inflammatory cytokine released by macrophages, upon exposure to pathogens thereby reducing inflammation.⁵¹⁻⁵⁴

Furthermore, the bioactive compounds of lemon grass have also shown potent antagonistic activity against viruses. Anti-viral effects of lemon grass against on-enveloped murine virus and have been reported. Murine novovirus is a surrogate virus of human novovirus, which is responsible for non-bacterial gastroenteritis epidemic worldwide. The lemon grass oil and citral used in the study reduced viral infectivity by coating the viral capsid and thus preventing it from binding to the host cell. Lemon grass and citral can be used to sanitize food and surfaces to prevent viral infections.⁵⁵

The bioactive compounds in citronella grass have been investigated for their anti-cancerous properties also. An emulsion of citral and lemongrass oil exhibited its anti-cancerous properties on cervical cell lines (HeLa and ME-180) by reducing cell proliferation and by initiating apoptosis. Also, a change in the mitochondrial membrane potential and increase in ROS production was observed the cancerous cells upon exposure to the emulsion. It has also been reported that two lipopolysaccharides containing (1 \rightarrow 4) linked b-d-Xylofuranose moiety, extracted from lemon grass, brought about apoptosis in Siha and LNCap reproductive cancer cell lines *via* the intrinsic pathway.⁵⁶⁻⁵⁸ Hence it is envisaged that the constituents of lemon grass may be used to form potent anti-cancer drugs in future.

CONCLUSION

Cymbopogon sp. is an aromatic grass that produces a diverse array of bioactive compounds and exhibits a wide range of therapeutic activities. It has already found applications in the cosmetic and perfumery industries due



to its strong fragrance. The therapeutic value of lemon grass and its essential oil may enable its use in herbal medicine in future.

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