Available online on 15.05.2025 at <http://jddtonline.info>

Journal of Drug Delivery and Therapeutics

Open Access to Pharmaceutical and Medical Research

Copyright © 2025 The Author(s): This is an open-access article distributed under the terms of the CC BY-NC 4.0 which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited



Open Access Full Text Article

Review Article

A Scoping Review on *Izkhar*: an Aromatic herb with multiple healing power

*Dr. Afreen Siddiqui¹ , Dr. Mohd Nauman Saleem² , Dr. Asif Iqbal Siddiqui³

1. PG Scholar, Department of Ilmul Saidla, AUTC, Karol Bagh, New Delhi – 110005
2. Assistant Professor, Department of Ilmul Saidla, AUTC, Karol Bagh, New Delhi
3. Associate Professor, Department of Ilmul Saidla, AUTC, Karol Bagh, New Delhi

Article Info:



Article History:

Received 13 Feb 2025
 Reviewed 28 March 2025
 Accepted 20 April 2025
 Published 15 May 2025

Cite this article as:

Siddiqui A, Saleem MN, Siddiqui AI, A Scoping Review on *Izkhar*: an Aromatic herb with multiple healing power, Journal of Drug Delivery and Therapeutics. 2025; 15(5):207-213 DOI: <http://dx.doi.org/10.22270/jddt.v15i5.7143>

*Address for Correspondence:

Dr. Afreen Siddiqui, PG Scholar, Department of Ilmul Saidla, AUTC, Karol Bagh, New Delhi – 110005

Abstract

Background: *Izkhar* (*C. citratus*) is one of the medicinal herbs with immeasurable pharmacological activities. Since times it has been used in folk and traditional medicine for its mesmerizing healing properties contained mainly in its essential oil. From its humble beginnings in kitchen gardens to its widespread cultivation on a large scale, this remarkable herb has come a long way. Initially used as a home remedy for relieving increased body temperature, as a taste enhancer in various savoury, and as stress busting agent due to its lemony odour, thus named Lemongrass. The aim is to review available data and insights from traditional sources as well as from modern studies.

Methods: A systematic literature search was conducted using specific keywords related to *Izkhar*, phytochemistry and pharmacological actions of *Cymbopogon citratus*. Several textbooks were utilized to extract information from Unani medicine sources and ancient texts

Discussion: It contains significant amount of terpenoids, flavonoids, phenolic compounds, antioxidant and other phytochemicals which are responsible for its various pharmacological actions.

Conclusion: Recently this drug has gained immense popularity in pharma industries on global level due to its various therapeutic effects from taking it orally to using it locally, like anti-obesity, anti-diabetic, anti-cancer, anti-gout, anti-inflammatory, anti-microbial etc. This article unveils its recently studied pharmacological actions and their scientifically proven therapeutic effects.

Keywords: *Izkhar*, Lemongrass, Essential oil, Citral, Citronella

Introduction:

Izkhar is a fast growing grass comprising *Cymbopogon* species, from Poaceae family. The name "*Cymbopogon*" originates from the Greek words "kymbe" (boat) and "pogon" (beard), reflecting the distinct arrangement of its flower spikes.¹ The Latin term "citratus" further emphasizes the plant's lemon-scented leaves. And *Izkhar* is an Arabic term.² According to various researches there are around 180 species of *Cymbopogon* and each specie is known to occur in a particular region of the world with different common name.³ *Cymbopogon flexuosus*, *Cymbopogon nardus* var. *nardus*, *Cymbopogon citratus*, *Cymbopogon pendulus*, *Cymbopogon winterianus*, and *Cymbopogon martinii* var. *motia* and *sofia* are the economically important species of this genus, mainly cultivated for its high yielding Essential oil content. This genus exhibits extensive diversity in their physical characteristics and the composition of essential oils, both between different species and within individual species. Different species yields different essential oil, namely lemongrass oil (obtained from *Cymbopogon citratus* (D.C.) Stapf, *Cymbopogon flexuosus* (Steud.) Wats., and *Cymbopogon*

pendulus (Nees ex Steud.) Wats.), Palmarosa or ginger grass oil (obtained from *Cymbopogon martinii*) and Citronella oil (obtained from *Cymbopogon nardus* and *Cymbopogon winterianus*)³ It is a native to the tropical regions of Asia, Africa and South America, India, Europe, Australia⁴ The cultivation of lemongrass is contributing in rapid growth of economy and India accounts for one-fourth of total production. It is known as Lemongrass because of its typical lemony odour of the essential oil. Also known as Cochin or Malabar Grass due to its maximum export from Cochin port in India.⁵ In Unani literature, according to *Ibn Sina*, Arabic *Izkhar* which is also known as *Izkhar Makki* is the best of all. *Izkhar Makki* have a strong rose like smell. *Discoridos*, describes two types of *Izkhar*. One which contains black seeds and another is without seeds. According to *Ghilani*, the varieties of *Izkhar* are, Simply *Izkhar* which belongs of foreign nations and the other is *Izkhar Ijamiya* which is produced in India.

Its Buds and Flowers are collectively known as *Izkhar Fuqa'a*.²

Methods:

The detailed description, phytochemistry and pharmacological properties of *Cymbopogon citratus* plant were searched online in databases by using keywords like "*Cymbopogon citratus* plant, Lemongrass uses, Taxonomy of lemongrass, Antioxidant properties of lemongrass, Anticancerous effect of *Cymbopogon citratus*, Antidiabetic effect of *Cymbopogon citratus*, Anti-microbial properties of *Cymbopogon citratus*, Anti-inflammatory effect *Cymbopogon citratus*, Hair growth effect of Lemongrass, etc. And Unani description was searched through different Unani literature on Mufradat written by ancient Unani scholars.

Discussion:

Plant Description-^{2,6,7,8,9,10,11,12}

It is a Short heighted plant approx. 1.8m, in which leaves are arranged in close proximity with roots, densely tufted and thick. Leaves are hard and needle like pointed. Colour of its leaves is having yellowish hue. Leaves present a strong smell. The plant contains a lot of white Flowers during its flowering season, which appears in bunches. The Indian variety of *Izkhar* is known as Rusa Grass. Caliph *Mamoon Rashed*, known Arabo Unani scholar used to have deep thoughts with this drug, hence it is also known as *Khayal Mamoon*. The oil prepared from its flowers is known as *Oleumgraminis Citrati* in US and Europe.

Taxonomical Description – ¹³

Kingdom : Plantae

Division : Magnoliophyta

Class : Liliopsida

Order : Poales

Family : Poaceae

Genus : Cymbopogon

Species : Citratus

Botanical Description- ¹³

Height – 6 ft(1.8m)

Width – 4 ft (1.2m)

Leaves – Strap like

Leaf Colour – Green Colour

Aroma – Citrus

Flowering Panicles – Rare

Stem – No

Vernacular Names (*Mutaradifat*) – ^{6,8,10,13,14}

Arabic – Izkhar, Teen maki, koraleer, Tayeb al gareeb, Khayal Mamoon

Bengali – Lebu Ghasa

English – Lemon grass, Camel grass, Citronella, Squinant

Ethiopia: Tej-sar

Hindi – Neemboo ghaas, Agni ghaas, Gandh heel, Gandh beel, Raj hans, Roop Basant, Kanton sondhi, Sera, Verveine

Italian: Cimbopogone

Indonesian: Sereh

Kannada – Nimbehannu Hullu

Malayalam – Naaranga Pullu

Malay: Sakumau

Mexican: Zacate limon

Persian – Kah maki, Galaf gokhir, Gorgiyah, Karta dushti, Muradasfaram

Portuguese: Capim-cidrao, Capim-santo

Roman – Toostas

Swedish: Citrongrass

Syrian – Sajas, Sajees

Tamil – Elumichai pul

Telugu – Nim makaya Gaddi

Thai: Ta-khrai

Turkish: Limon out

Unani – Afridus, Yasqoos, Tofalas, Sanjunas

Temperament (*Mizaj*)- ^{2,7,10,12}

Scholars have different opinion for its *Mizaj* (temperament)

1. According to *Ibn sina* - Garm khushk 2
2. According to *Tameem hujazi* - Garm Khushk 1
3. Some have thought - Garm khushk 3
4. Others- Garm 2 khushk 1, Garm tar 1

Ibn Jarheeh, describes the *Mizaj* of different parts of the plant,

1. Flowers- garam 1, khushk 2
2. Roots, leaves, branches – garm tar
3. Essential oil – Garam khushk 2

Part Used (*Ajza-i-Mustamila*) –^{2,10,12}

Flowers, buds, roots, leaves.

Actions (*Afaa'l*) - ^{2,6,7,8,9,10,11,12}

Astringent, Antiinflammatory, Demulcent, Laxitive, Expectorant, Deobstruent, Anti-haemorrhagic, Digestive, cardio tonic, Liver tonic, Emmenagogue, Purgative, Analgesic, Appetizer, Carminative, Anti-spasmodic.

Uses (*Istema'lat*)- ^{2,7,10}

Phelgmetic emesis and nausea – 4.5 masha root powder + 4.5 masha siyah mirch powder Bell's palsy and paralysis – leaf decoction as nutool, Ascites, Inflammation of spleen- along with *turanjbeen*, Renal and pulmonary disorders, in disorders of uterus as abzan, vitiligo, hair growth, oral ulcers. In ancient Arab

the solution of this powdered drug is used to wash hands and was known as *Ghusul*, due to its Antiseptic properties.

Adverse effect (*Muzir*) – 2

It may cause a headache and may cause an adverse effect on the kidney.

Also, may cause adverse effects in people with hot temperament

Corrective (*Muslah*) –2

In case of headache olfaction of Aas, Rose, Sandalwood, and Lotus.

And Honey is used as a corrective in case of renal impairment.

Substitute (*Badal*)-2,7,10,12

Aaqarqarha

Dose (*Miqdar Khuraq*) – 2

1.75 g to 4.5 g

Phytochemical Constituents -1,13,14,15,16,17,

Lemon grass is a good source of folic acid, magnesium, zinc, copper, iron, potassium, calcium, and manganese. It also contains vitamins A, C and E, niacin, and riboflavin, protein, antioxidants, and mineral nutrients, such as Nitrogen, Phosphorous, Potassium, Sulphur, Magnesium, Calcium, Zinc, Manganese, Iron, Copper and hence can be used as a nutritional supplement.

Table 1: Composition of Minerals in *Cymbopogon citratus*

Nutrients	Composition
N	0.74%
P	0.07%
K	2.12%
S	0.19%
Mg	0.15%
Ca	0.36%
Zn	35.51 ppm
Mn	155.82%
Fe	126.73%
Cu	56.64 ppm

Lemon grass contains on average 0.3% oil and citral is the main component of all. However different species of Lemon grass shows different composition of lemongrass oil. Essential oil of the *Cymbopogon* species comprises of mono- and sesquiterpenoids, which may be mainly Geranial and Neral forms of citral, limonene, citronellal, β -myrcene, linalool, and geraniol.

It also contains Terpenoids, flavonoids - such as luteolin and apigenin glycosides and proanthocyanidins, phenols, tannins, alkaloids, cardiac glycosides & coumarins.¹⁸

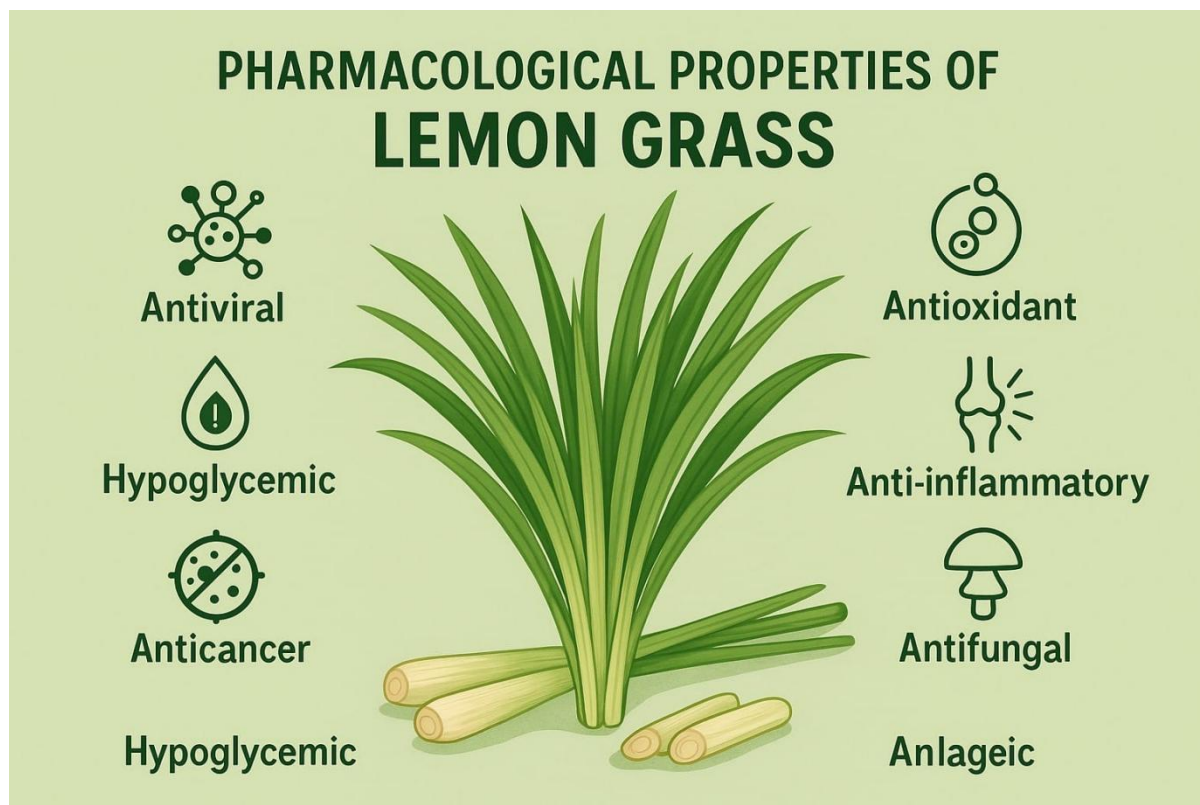
Table 2: Composition of essential oil in *Cymbopogon citratus*¹

Essential oil composition	Percentage of components
Citral α	40.8
Citral β	32
Nerol	4.18
Geraniol	3.04
Citronellal	2.10
Terpinolene	1.23
Geranyl acetate	0.83
Myrcene	0.72
Terpinol	0.45
Methylheptenone	0.2
Borneol	0.1 - 0.4
Linalyl acetate	0.1
α Pinene	0.07
β Pinene	0.04
Limonene	traces
Linalool	traces
β -caryophyllene	traces

Pharmacological Activity

Cymbopogon citratus is a pharmacologically important plant and has various phytochemicals and biologically active phytocompounds. This herb has Anti-inflammatory, Antioxidant, Anti-bacterial, Fungicides, Antiviral, Antispasmodic, Antipyretic, Diuretic, Anti-gout, Anti-Dandruff, Anti-Cancerous, Mosquito repellent, Anthelmintic activity. The detailed pharmacological properties are as follows.

- 1. Anti-inflammatory activity-** - Many studies suggested that, the plant contains anti-inflammatory actions, effective in gingivitis, periodontitis, skin inflammation. It inhibits the production of IL-1b and IL-6 and pro-inflammatory cytokines such as TNF- α by contained flavonoids such as luteolin and apigenin glycosides and proanthocyanidins.^{19,20}
- 2. Antioxidant activity-** Lemon grass essential oil may act as free radical scavenger, preventing oxidative damage of cellular components, and it also inhibits enzymes such as collagenase, elastase, and hyaluronidase.^{21,22}
- 3. Antibacterial activity-** It has been reported that low concentrations of its essential oil inhibit bacterial growth while a higher concentration irreversibly destruct bacterial cell. It can kill many Pathogenic bacteria e.g., *Escherichia coli*, *Staphylococcus aureus*, *Bacillus cereus*, as revealed in many studies.^{23,24,25,26,27,28,29}



- 4. Fungicidal activity-** Researches indicated that lemongrass essential oil holds promise in treating various skin conditions, including cutaneous candidiasis—a fungal infection caused by *Candida albicans*. The antifungal properties of the oil is from its active components, such as citral, geranial, and neral, which disrupt the fungal cell structure and surface morphology. These effects help in reducing infections and showcase lemongrass essential oil as a potential natural remedy for skin-related fungal issues. A study on melon seeds showed that lemongrass essential oil and grounded leaf powder of lemongrass can protect melon seeds from fungus.^{30,31,32}
- 5. Antiviral activity-** A Research on measles virus injected into Vero Cells showed significant prevention in viral cell replication.^{33,34}
- 6. Antileishmanial activity-** Santin et al., highlights the significant potential of citral, against the parasite *Leishmania amazonensis*, in combating leishmaniasis. The study is conducted in vitro, providing controlled conditions for observing the effects. Results indicate that both the essential oil and citral show notable activity against the parasite.³⁵
- 7. Antipyretic activity-** Studies have shown that lemongrass contains bioactive compounds such as citral, flavonoids, and essential oils, which contribute to its antipyretic effects. Traditionally, lemongrass tea or extracts have been used in folk medicine to decrease fever and inflammation.³⁶
- 8. Diuretic activity-** a study published in the journal of Renal Nutrition investigated the effects of lemongrass tea consumption on renal function in healthy individuals. The findings indicated that regular intake of lemongrass tea led to significant increase in urine output and urinary electrolyte excretion, confirming its diuretic activity.³⁷
- 9. Anti-diabetic activity -** An in vitro study was conducted by Mirghani, et al., showing that essential oil extracted from the its stalk increases β -glucosidase inhibition and rate of carbohydrate digestion, thus resulting in reduction of blood sugar level.³⁸ Another study on Albino mice showing effective results of aqueous extract of *C. citratus* root and flower in reduction of fasting and postprandial blood sugar, induced by Dexamethasone.³⁹
- 10. Anti-gout activity-** An in vitro study was conducted by Mirghani, et al., on lemongrass showed that its essential oil increases xanthine oxidase inhibition, which decreases uric acid production and helps in prevention of gout.³⁸
- 11. Anti-Dandruff activity-** Citral contained by the plant is reported to show anti dandruff effect. This effect is due to Anti-fungal properties, specifically against dandruff-associated pathogens, which interacts with ergosterol present in fungus membrane and results in membrane instability causing mitochondrial abnormality and cell death.^{40,41,42}
- 12. Anti-Cancerous activity-** The essential oil from lemongrass was investigated for their ability to induce apoptosis in human leukaemia HL-60 cells. Geraniol showed high enzyme (Glutathione-S-transferase) GST-inducing activity in the mucosa of the small and large intestines, which was about 2.5-fold greater than controls.^{43,44,45}

13. Mosquito repellent activity- investigations revealed that lemongrass oil provides approximately 30 minutes of safety time against mosquitoes, which is notably shorter compared to the protection offered by the widely used chemical repellent N,N-diethyl-m-toluamide (DEET). Despite its limited duration, lemongrass oil is considered a potential herbal alternative due to its natural composition and eco-friendly properties.⁴⁶

14. Anthelmintic activity - Lemongrass demonstrated significant efficacy against worms on live *Fasciola gigantica*.⁴⁷

15. Hair growth promoter activity- a study conducted on male albino rats showed that *Cymbopogon citratus* possess hair growth activity in low concentration and has hasten the growth of hair follicles. There was a visible increase in the length of hair follicle.⁴⁸

16. Anti-anxiety activity- A study investigates the anxiolytic-like effects of *Cymbopogon citratus* (lemongrass) essential oil in mice, focusing on its interaction with the GABAergic system. The research employs behavioural tests like the light/dark box (LDB), marble-burying test (MBT), and forced-swimming test (FST), alongside neurochemical evaluations to understand the EO's mechanism of action, revealing that the anxiolytic effects are mediated by the GABAA receptor-benzodiazepine complex, supporting its traditional use in folk medicine.⁴⁹

17. Anticonvulsant- A study compared the anticonvulsant activities of essential oils (EOs) from *Cymbopogon winterianus* and *Cymbopogon citratus* in male Swiss mice, focusing on their effects on induced seizures and sedation. The findings highlight that both EOs exhibit significant anticonvulsant properties, particularly in the pentylenetetrazol model, with *C. citratus* showing superior efficacy in increasing latency to convulsions and death. The research suggested that the anticonvulsant effects of these EOs may be linked to GABAergic neurotransmission rather than radical-scavenging activity.⁵⁰

18. Analgesic - *Cymbopogon citratus* essential oil is effective at relieving pain. Studies using hot-plate tests, acetic acid-induced writhing tests, and formalin tests suggest that the oil's pain-relieving action occurs both in the central nervous system and in other parts of the body⁵¹

19. Antiemetic - *C. citratus* was found to be significant as an anti-emetic drug at 500mg/kg dose.⁵²

Conclusion

Lemongrass essential oil (*Cymbopogon citratus*) emerges as a multifaceted natural product with immense therapeutic and industrial potential. Renowned for its antimicrobial, anti-inflammatory, antifungal, and antioxidant properties, it bridges the gap between traditional remedies and contemporary medical applications. Its active compounds, including

citral, geranial, and nerol, underpin its effectiveness in treating a spectrum of health conditions. Furthermore, its versatile applications in cosmetics, pharmaceuticals, food preservation, and agriculture underscore its utility across diverse industries.

With advancements in extraction technologies, the quality and yield of lemongrass oil have improved, paving the way for innovative uses. As ongoing research uncovers new benefits and applications, lemongrass essential oil continues to solidify its position as a valuable and sustainable resource in both traditional and modern domains.

Acknowledgment: Thankful to PG department of Ilmu Saidla, AUTC, Karol Bagh for providing an environment to work efficiently.

Conflict of Interest: Nil

Author Contributions: All authors have equal contribution in the preparation of manuscript and compilation.

Source of Support: Nil

Funding: The authors declared that this study has received no financial support.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data supporting in this paper are available in the cited references.

Ethical approval: Not applicable.

References

- Shah, G., Shri, R., Panchal, V., Sharma, N., Singh, B., & Mann, A.S. Scientific basis for the therapeutic use of *Cymbopogon citratus*, stapf(Lemongrass). Journal of advanced pharmaceutical technology & research, 2011;2(1):3. <https://doi.org/10.4103/2231-4040.79796> PMID:22171285 PMCid:PMC3217679
- Ghani N . Khazain ul Advia 2006, Idara Kitab us Shifa, New Delhi p. 212-213., 190.
- Akhila, A. Essential Oil-Bearing Grasses: The Genus *Cymbopogon*; CRC Press: Boca Raton, FL, USA, 2009. Tibenda, J.J.; Yi, Q.; Wang, X.; Zhao, Q. Review of phytomedicine, phytochemistry, ethnopharmacology, toxicology, and pharmacological activities of *Cymbopogon* genus. Front. Pharmacol. 2022, 13, 997918. <https://doi.org/10.3389/fphar.2022.997918> PMID:36105217 PMCid:PMC9465289
- Suman P.S. Khanuja, Ajit K. Shasany, Anubha Pawar, R.K. Lal, M.P. Darokar, A.A. Naqvi, S. Rajkumar, V. Sundaresan, Nirupama Lal, Sushil Kumar, Essential oil constituents and RAPD markers to establish species relationship in *Cymbopogon* Spreng. (Poaceae), Biochemical Systematics and Ecology, 2005;33(2):171-186, <https://doi.org/10.1016/j.bse.2004.06.011>
- Gaba, J.; Bhardwaj, G.; Sharma, A. Lemongrass. In Antioxidants in Vegetables and Nuts-Properties and Health Benefits; Nayik, G.S., Gull, A., Eds.; Springer: Singapore, 2020; pp. 75-103. https://doi.org/10.1007/978-981-15-7470-2_4
- Anonymous. Standardization of single drugs of Unani Medicine Part -3rd, CCRUM in Unani Medicine, New Delhi, p- 137-144.
- Sina I. Al Qanoon Fit Tib. (Urdu translation by Kantoori) Volume-2. New Delhi: Idara Kitabul Shifa; YMN;2010 Page no. 272.
- Abdul M., Jadedd Bustan al mufradat, , Idara Kitab us Shifa, New Delhi, p- 60, 61

9. Ramlubhay. Bayan ul adviya , jild 1, Goswami pharmacy, Delhi p -40-41
10. Khan M.A. Muhet Azam (Urdu Translation) Vol. - 1 CCRUM. New Delhi. p-263-267
11. Tareeq A.N. Taj ul Mufradat, Idara Kitab us Shifa, New Delhi p-42-43
12. Usmani I. Tanqeehul Mufradat, Idara Kitab us Shifa, New Delhi p -23-24
13. Fathima Thasrin J., Anitha V. (2023), Nutritional and Nutraceutical Potentials of Lemongrass (*Cymbopogon citratus*), International Journal of Current Science Research and Review, 6(5), 2881-2886.
14. Thasrin FJ, Anitha V. Nutritional and Nutraceutical Potentials of Lemongrass (*Cymbopogon citratus*). Int J Curr Sci Res Rev. 2023;6(5):2881-2886. <https://doi.org/10.47191/ijcsrr/V6-i5-24>
15. Mahouachi W, Saeed A, Rehman R, Nisar S. Lemongrass: a review on its botany, properties, applications and active components. Int J Chem Biochem Sci. 2016;9:79-84.
16. Wifek M, Saeed A, Rehman R, Nisar S. Lemongrass: a review on its botany, properties, applications and active components. International Journal of Chemical and Biochemical Sciences. 2016 Jan;9(1):79-84.
17. Kusuma IY, Perdana MI, Vágvölgyi C, Csupor D, Takó M. Exploring the clinical applications of lemongrass essential oil: A scoping review. Pharmaceuticals. 2024 Jan 25;17(2):159. <https://doi.org/10.3390/ph17020159> PMID:38399374 PMID:PMC10892616
18. Gupta PK, Rithu BS, Shruthi A, Lokur AV, Raksha M. Phytochemical screening and qualitative analysis of *Cymbopogon citratus*. Journal of Pharmacognosy and Phytochemistry. 2019;8(4):3338-43.
19. deAndrade, S.F.; Rocha, C.; Pinheiro, E.J.; Pereira-Leite, C.; Costa, M.D.C.; Rodrigues, L.M. Revealing the protective effect of topically applied *Cymbopogon citratus* essential oil in human skin through a contact model. Cosmetics 2023; 10-29. <https://doi.org/10.3390/cosmetics10010029>
20. Boukhatem MN, Ferhat MA, Kameli A, Saidi F, Kebir HT. Lemon grass (*Cymbopogon citratus*) essential oil as a potent anti-inflammatory and antifungal drug. Libyan J Med. 2014;9:1-11. <https://doi.org/10.3402/ljm.v9.25431> PMID:25242268 PMID:PMC4170112
21. Kusumawati, I.; Indrayanto, G. Natural antioxidants in cosmetics. Stud. Nat. Prod. Chem. 2013;40:485-505, <https://doi.org/10.1016/B978-0-444-59603-1.00015-1>
22. Leelapornpisid, P.; Wickett, R.R.; Chansakaow, S.; Wongwattananukul, N. Potential of native Thai aromatic plant extracts in antiwrinkle body creams. J. Cosmet. Sci. 2015;66:219-231.
23. Mukarram M, Choudhary S, Khan MA, Poltronieri P, Khan MM, Ali J, Kurjak D, Shahid M. Lemongrass essential oil components with antimicrobial and anticancer activities. Antioxidants. 2022;11(1):1-10. <https://doi.org/10.3390/antiox11010020> PMID:35052524 PMID:PMC8773226
24. Sahal, G.; Woerdenbag, H.J.; Hinrichs, W.L.; Visser, A.; Tepper, P.G.; Quax, W.J.; van der Mei, H.C.; Bilkay, I.S. Antifungal and biofilm inhibitory effect of *Cymbopogon citratus* (lemongrass) essential oil on biofilm forming by *Candida tropicalis* isolates; an in vitro study. J. Ethnopharmacol. 2020;246:112188. <https://doi.org/10.1016/j.jep.2019.112188> PMID:31470085
25. Mangalagiri, N.P.; Panditi, S.K.; Jeevignunta, N.L.L. Antimicrobial activity of essential plant oils and their major components. Heliyon 2021;7:e06835. <https://doi.org/10.1016/j.heliyon.2021.e06835> PMID:33997385 PMID:PMC8099760
26. Perdana, M.I.; Ruamcharoen, J.; Panphon, S.; Leelakriangsak, M. Antimicrobial activity and physical properties of starch/chitosan film incorporated with lemongrass essential oil and its application. LWT Food Sci. Technol. 2021;141:110934. <https://doi.org/10.1016/j.lwt.2021.110934>
27. Perdana, M.I.; Panphon, S.; Ruamcharoen, J.; Leelakriangsak, M. Antimicrobial property of cassava starch/chitosan film incorporated with lemongrass essential oil and its shelf life. J. Pure Appl. Microbiol. 2022;16:2891-2900. <https://doi.org/10.22207/JPAM.16.4.64>
28. Schweitzer, B.; Balázs, V.L.; Molnár, S.; Szögi-Tatár, B.; Böszörményi, A.; Palkovics, T.; Horváth, G.; Schneider, G. Antibacterial effect of lemongrass (*Cymbopogon citratus*) against the aetiological agents of pitted keratolysis. Molecules 2022;27:423. <https://doi.org/10.3390/molecules27041423> PMID:35209211 PMID:PMC8878996
29. Schneider, G.; Steinbach, A.; Putics, Á.; Solti-Hodován, Á.; Palkovics, T. Potential of essential oils in the control of *Listeria monocytogenes*. Microorganisms 2023, 11, 1364. <https://doi.org/10.3390/microorganisms11061364> PMID:37374865 PMID:PMC10301788
30. Bakkali F, Averbeck S, Averbeck D, Idaomar M. Biological effects of essential oils - A review. Food Chem Toxicol. 2008;46(2):446-75. <https://doi.org/10.1016/j.fct.2007.09.106> PMID:17996351
31. Tyagi AK, Malik A. Liquid and vapour-phase antifungal activities of selected essential oils against *Candida albicans*: microscopic observations and chemical characterization of *Cymbopogon citratus*. BMC Complement Altern Med. 2010;10(1):65. <https://doi.org/10.1186/1472-6882-10-65> PMID:21067604 PMID:PMC2994787
32. Bankole SA, Joda AO, Ashidi JS. The use of powder and essential oil of *Cymbopogon citratus* against mould deterioration and aflatoxin contamination of 'egusi' melon seeds. Journal of Basic Microbiology: An International Journal on Biochemistry, Physiology, Genetics, Morphology, and Ecology of Microorganisms. 2005 Feb;45(1):20-30. <https://doi.org/10.1002/jobm.200410435> PMID:15678559
33. Chaudhary T, Varshney C, Khan A, Singh B, Jain S, Tiwari AK, Nagarjan K, Singh Ap. Pharmacological Potential Of Lemongrass Oil: A Systematic Review And Meta Analysis. Biochemical & Cellular Archives. 2024 Apr 1;24(1). <https://doi.org/10.51470/bca.2024.24.1.587>
34. Sharma R, Rao R, Kumar S, Mahant S, Khatkar S. Therapeutic potential of citronella essential oil: A review. Curr Drug Discov Technol. 2018;16(4):330-339 <https://doi.org/10.2174/1570163815666180718095041> PMID:30019646
35. M.R. Santin, A.O. dos Santos, C.V. Nakamura, B.P. Dias Filho, I.C.P. Ferreira, T. Ueda Nakamura. (2009). In vitro activity of the essential oil of *Cymbopogon citratus* and its major component (citral) on *Leishmania amazonensis*. Parasitology research. 105(6):1489-1496. <https://doi.org/10.1007/s00436-009-1578-7> PMID:19669793
36. Nyamath S, Karthikey B. In vitro antibacterial activity of lemongrass (*Cymbopogon citratus*) leaves extract by agar well method. J Pharmacogn Phytochem. 2018;7(3):1185-1188.
37. Christopher E. Ekpenyong, Nyebuk E. Daniel, Atim B. Antai, Effect of Lemongrass Tea Consumption on Estimated Glomerular Filtration Rate and Creatinine Clearance Rate. Journal of Renal Nutrition, 2015; 25(1):57-66. <https://doi.org/10.1053/j.jrn.2014.08.005> PMID:25440110
38. Mirghani ME, Liyana Y, Parveen J. Bioactivity analysis of lemongrass (*Cymbopogon citratus*) essential oil. International food research journal. 2012 Aug 1;19(2):569-75.)
39. Abbas N, Al-Sueaadi MH, Rasheed A and Ahmed ES: Study of antidiabetic effect of lemongrass (*Cymbopogon citratus*) aqueous roots and flower extracts on albino mice. Int J Pharm Sci Res 2018; 9(8): 1000-04. [https://doi.org/10.13040/IJPSR.0975-8232.9\(8\).1000-04](https://doi.org/10.13040/IJPSR.0975-8232.9(8).1000-04)
40. Galuppi, R.; Aureli, S.; Bonoli, C.; Ostanello, F.; Gubellini, E.; Tampieri, M.P. Effectiveness of essential oils against *Malassezia* spp.: Comparison of two in vitro tests. Med. Mycol. (Mikol. Lek.) 2010, 17, 79-84. 65.
41. Khunkitti, W. In vitro antimicrobial and antioxidant activities of some *Cymbopogon* species. In Essent Oil-Bear Grasses. The Genus

- Cymbopogon; Akhila, A., Ed.; CRC Press: Boca Raton, FL, USA, 2010; pp. 167-184. *Pharmaceuticals* 2024, 17, 159 13 of 13 66.
42. Sattary, M.; Amini, J.; Hallaj, R. Antifungal activity of the lemongrass and clove oil encapsulated in mesoporous silica nanoparticles against wheat's take-all disease. *Pestic. Biochem. Phys.* 2020, 170, 104696. <https://doi.org/10.1016/j.pestbp.2020.104696> PMID:32980050
43. Kumar A, Malik F, Bhushan S, Sethi VK, Shahi AK, Kaur J, Taneja SC, Ghulam N, Qazi GN, Singh J. An essential oil and its major constituent isomenthyl acetate induce apoptosis by increased expression of mitochondrial cytochrome c and apical death receptors in human leukaemia HL-60 cells. *Chem-Biol.* 2008;171:332-47. <https://doi.org/10.1016/j.cbi.2007.10.003> PMID:18070620
44. Zheng GQ, Kenney PM, Tam TDT. 1993. Potential anticarcinogenic natural products isolated from lemongrass oil and galanga root oil. *J Agric Food Chem.* 1993; 41:153-6. <https://doi.org/10.1021/jf00026a001>
45. Ghosh K. Anticancer effect of lemongrass oil and citral on cervical cancer cell lines. *Pharmacognosy Communications.* 2013 Oct 1;3(4).
46. Vidya Prabhakar K, Kinnera K, Krishna Priya K, Abraham Peele K, Author C. Investigation of the repellence activity of bio-out, a natural mosquito repellent. *Int J LifeSci Bt Pharm.* 2013;2:109-114.
47. Sharma R, Rao R, Kumar S, Mahant S, Khatkar S. Therapeutic potential of citronella essential oil: A review. *Curr Drug Discov Technol.* 2018;16(4):330-339. <https://doi.org/10.2174/1570163815666180718095041> PMID:30019646
48. Fernandez . R A , Refomina. G N . Hair growth activity of lemongrass (*Cymbopogon citratus*) in male albino rat; Sep 2016. Researchgate.
49. Costa CA, Kohn DO, de Lima VM, Gargano AC, Flório JC, Costa M. The GABAergic system contributes to the anxiolytic-like effect of essential oil from *Cymbopogon citratus* (lemongrass). *J Ethnopharmacol.* 2011 Sep 1;137(1):828-36. doi: 10.1016/j.jep.2011.07.003. Epub 2011 Jul 7. PMID: 21767622. <https://doi.org/10.1016/j.jep.2011.07.003> PMID:21767622
50. Silva MR, Ximenes RM, da Costa JG, Leal LK, de Lopes AA, Viana GS. Comparative anticonvulsant activities of the essential oils (EOs) from *Cymbopogon winterianus* Jowitt and *Cymbopogon citratus* (DC) Stapf. in mice. *Naunyn Schmiedebergs Arch Pharmacol.* 2010 May;381(5):415-26. <https://doi.org/10.1007/s00210-010-0494-9> PMID:20237771
51. (Viana GS, Vale TG, Pinho RS, Matos FJ. Antinociceptive effect of the essential oil from *Cymbopogon citratus* in mice. *J Ethnopharmacol* 2000;70:323-7. [https://doi.org/10.1016/S0378-8741\(99\)00168-3](https://doi.org/10.1016/S0378-8741(99)00168-3) PMID:10837994
52. Yaqeen Z, Naqvi NAH, Fatima N, Imran H, Sohail T, Rahman AU, Rehman Z, Syed S. Evaluation of anti-emetic activity of *Cymbopogon citratus* (DC.) Stapf. *Int J Biol Biotech.* 2011;8(3):419-422.