

Review article

Study the Effect of Lemongrass and Rosemary Extracts against Bacterial Pathogens

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ABSTRACT

The study aims to study the antibacterial effects of lemongrass and rosemary extracts against different types of bacteria. According to studies, rosemary extract has antibacterial properties against both Gram-positive and Gram-negative bacteria, such as *Pseudomonas aeruginosa*, *Escherichia coli*, and *Staphylococcus aureus*. Bioactive substances including rosmarinic acid and carnosic acid are responsible for the antibacterial properties of rosemary extract. *Salmonella enterica*, *Listeria monocytogenes*, and *Bacillus cereus* are just a few of the microorganisms that lemongrass extract has been shown to have antibacterial activity against. Citral a significant part of the essential oil, is the main cause of lemongrass's antibacterial qualities. It has also been discovered that combining the extracts of lemongrass and rosemary has a synergistic effect that increases the antibacterial action against specific bacteria. It is thought that the various modes of action of the bioactive substances included in these extracts are what cause this synergistic impact. All things considered, the data that is now available points to the possibility of using extracts of rosemary and lemongrass as natural antibacterial agents against a range of harmful microorganisms.

Keywords: Antibacterial effect, Lemongrass, Medicinal Plants, *Rosmarinus officinalis* L.

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1. INTRODUCTION

Lemongrass and rosemary are among the herbs that have shown potential in treating bacterial infections thanks to their antibacterial properties. It has been observed that two substances found within rosemary, carnosic acid and rosmarinic acid, exhibit antibacterial activities against many microorganisms such as *Staphylococcus aureus*, *B. subtilis*, and *E. coli* [1-3]. On the other hand, the potential antimicrobial effects of citral, which is frequently referred to as antibacterial, and other compounds present in lemongrass have not been adequately explored in this regard. Methanolic extract form of lemongrass was tested against *Klebsiella pneumoniae*, *E. coli*,

Pseudomonas aeruginosa, *Proteus mirabilis*, *Enterococcus faecalis*, and *S. aureus*, where a broad range of antibacterial activity was displayed. Among the microorganisms tested, lemongrass demonstrated the highest observed antibacterial activity of all of those tested [1]. Different bioactive constituents with antimicrobial activity such as phenolic acids, flavonoids, and terpenoids that were identified in both rosemary and lemongrass extracts are believed to be responsible for their antibacterial properties [3]. These substances can kill bacteria by causing disruptions of bacterial cell membranes, targeting bacterial metabolism or producing reactive oxygen species which

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are damaging to the bacterium's DNA and proteins [3]. Also, the effects of rosemary and lemongrass extracts have been established to be synergistic.

It has been demonstrated that the extracts of lemongrass and rosemary have strong antibacterial properties against a variety of bacteria, making them useful natural antimicrobials for the management and avoidance of bacterial illnesses—Synergistic Impact of Lemongrass Methanolic Extract and Certain [1].

2. MEDICINAL PLANTS

For thousands of years, medicinal plants have been an essential part of traditional medicine; now, almost 80% of the world's population gets their main healthcare from them [1]. These plants are abundant in bioactive substances, and many different cultures have researched and used their therapeutic benefits [2, 3]. Natural products are an important source of therapeutic molecules, and human groups have been passing down empirical information about their beneficial effects for generations [4].

Modern extraction techniques, including ultrasound-assisted and supercritical fluid extraction methods, are being used in the extraction operation, which is a significant stage in the research of the bioactive compounds from plant sources [4]. Phytochemical research has been greatly enhanced by the introduction of sophisticated instruments for the qualitative and quantitative evaluation of phytochemicals, such as high-performance liquid chromatography (HPLC) and liquid chromatography/mass spectrometry (LC/MS) [4].

Many ailments have been treated with medicinal plants, and research is still being done on their potential for therapeutic use. Ginkgo biloba, for instance, has been investigated for its potential to cure dementia and Alzheimer's disease and is well known for promoting brain health [5]. Due to its orange color, turmeric is an anti-inflammatory supplement because it may have anti-cancer effects and stop DNA changes. In summary, medicinal plants are still essential to healthcare since they provide a natural and maybe safer substitute for pharmaceuticals. Their medicinal potential is enormous, and studies are still being done to find out how to best utilize their advantages and uncover their secrets for the benefit of human health [5].

2.1. The importance of medicinal plants

The following are only a few advantages of using therapeutic plants:

1. Increasing Immunity: Plants that fight infections, lower stress levels, and boost immunity include tulsi and giloy [1].
2. Healthy Hair and Skin: Bhingaraj encourages liver protection, and healthy skin, and hair [1].
3. Healing Properties: Aloe Vera efficiently treats infections, wounds, and skin conditions [1].
4. Natural Healing: Herbal medicine offers a natural means of promoting and mending health [5].
5. Cost-Effective: Using herbal treatments can be a highly effective and affordable healthcare solution [5].
6. Reduced adverse Effects: When compared to pharmaceuticals, herbal medications have fewer adverse effects [5].
7. Safe Testing: Under expert supervision, herbal remedies can be tested safely [5]. These advantages show how beneficial medicinal herbs are for naturally enhancing health and well-being.

3. *Rosmarinus officinalis* L

Rosemary (*Rosmarinus officinalis* L.) is a highly valued herb with significant therapeutic and fragrant properties. This plant is a member of the family Lamiaceae. Evergreen and perennial, rosemary has aromatic, needle-like leaves [6]. Herbs like rosemary have long been utilized in traditional medicine and cosmetics. They are also added to cuisine as flavorings. Aside from its therapeutic use, *R. officinalis* L essential oil is significant for its potent antimicrobial, cytotoxic, anti-mutagenic, antioxidant, *antiphlogistic*, and chemopreventive qualities [7]. *R. officinalis* essential oil was found to have the following main constituents: 1,8-cineol (38.5%), camphor (17.1%), α -pinene (12.3%), limonene (6.23%), camphene (6.00%), and linalool (5.70%). Eleven components, accounting for 78.25% of the essential oil, were found using GC's chemical study of rosemary. Alpha-pinene (23.93%), camphen (8.7%), verbenon (15.44%), camphor (10.97%), p-cymene (7.48%), and 3-Octanone (5.63%) are among the essential oil's main constituents.[8].

R. officinalis L. belongs to the Kingdom Plantae and is classified under the Order Lamiales. It is a member of the Family Lamiaceae and falls within the Genus Rosmarinus. The species is scientifically referred to as *R. officinalis* L [8]. Figure 1 shows the morphological features of the *R. officinalis* L.



Fig. 1. Photograph of the *Rosmarinus officinalis* L showing the external morphological features.

4. Lemongrass

lemongrass is a herb with several health advantages. Antioxidants, vitamins, minerals, manganese, zinc, iron, potassium, magnesium, phosphorus, and B and C vitamins are all present in it. Lemonal, a substance with antifungal and antibacterial qualities, is abundant in lemongrass. Its possible advantages include increasing the synthesis of red blood cells, assisting in the removal of toxins, enhancing dental health, and having antibacterial and antifungal qualities. Among its other advantages, lemongrass may aid in the treatment of skin disorders, digestive issues, and mental health [9].

Cymbopogon citratus, commonly known as lemongrass, belongs to the Kingdom Plantae and is classified under the Order Poales. It is a Family Poaceae member and part of the Genus Cymbopogon Spreng. The species is scientifically named *Cymbopogon citratus* [9].

5. APPLICATION of ROSEMARY and LEMONGRASS OIL

The results of different research articles indicate that the essential oils of rosemary and lemongrass are suitable for external and internal usage. Topical Use, the results of the previous study show that the essential oils of lemongrass and rosemary have strong antibacterial properties, which makes them appropriate for topical use [10]. The broad-spectrum antibacterial activity of rosemary oil has been shown against a variety of Gram-positive and Gram-negative bacteria linked to food spoiling and skin diseases [11]. Significant antibacterial action has been demonstrated by lemongrass oil, especially against spore-forming bacteria such as *B. cereus* and *B. thuringiensis*, which are pertinent for topical skin applications. Both rosemary and lemongrass essential oils may find application in topical antimicrobial compositions, such as gels and ointments, for medical and food preservation purposes [10]. Internal Use: Despite the search results' greater emphasis on topical and antimicrobial uses, there is no proof that extracts of rosemary and lemongrass aren't safe for internal use. Particularly well-known for its therapeutic use, rosemary oil has been researched for its chemopreventive, anti-inflammatory, and antioxidant qualities. The wide spectrum of positive health effects of both rosemary and lemongrass oils are attributed to their bioactive volatile components. According to the data presented in the research results, rosemary and lemongrass extracts can be used internally or externally, depending on the specific use and formulation [11].

Applying rosemary and lemongrass topically may have the following benefits: Antimicrobial Effect: When applied topically, essential oils of lemongrass and rosemary have powerful antibacterial qualities that make them useful against a variety of bacteria.

- **Antifungal Activity:** Research on the antifungal properties of lemongrass essential oil against fungi such as *Aspergillus niger* and *Alternaria alternata* has demonstrated potential benefits for skin disorders [12].
- **Skin Infections:** These extracts are appropriate for dermatological use since they can be applied topically to treat superficial skin infections such as *Propionibacterium acnes* [2].
- **Therapeutic Potential:** The antibacterial qualities of rosemary and lemongrass extracts in essential oil-based gels and ointments can provide therapeutic benefits for skin conditions.
- **Natural Preservation:** Because these extracts can stop the growth of bacteria linked to food spoiling and skin diseases, they can be used in topical preparations as a natural preservation technique [11].

Topical application of extracts from rosemary and lemongrass can provide several advantages, such as antimicrobial, antifungal, and therapeutic actions, which makes them useful for dermatological and skincare applications [12].

6. TYPES of PLANT EXTRACTS

- **Essential oils:** These oils include substances that might damage bacterial membranes, such as phenolics and terpenes.
- **Alkaloids:** Berberine, for example, can prevent bacteria from synthesizing DNA.
- **Flavonoids:** They can disrupt bacterial metabolism and frequently function as antioxidants [4].

7. MECHANISMS of ACTION

- **Cell membrane disruption:** Extracts of lemongrass and rosemary harm the bacterial cell membrane, allowing cell contents to seep out.
- **Protein synthesis inhibition:** Certain substances can attach to ribosomes and stop the synthesis of vital proteins.
- **DNA interference:** The extracts block the enzymes topoisomerase and DNA gyrase, which are essential for DNA replication.
- **Enzyme inhibition:** By blocking bacterial enzymes, compounds can interfere with metabolic processes [6].
- **Disruption of quorum sensing:** Certain plant extracts can hinder bacterial communication, which lowers pathogenicity.
- **Cell Wall:** Phenolic chemicals, in particular, can target components such as peptidoglycan.
- **Cell Membrane:** Different extract components can alter the membrane's phospholipids and proteins. Protein synthesis may be impeded by binding to the ribosomal subunits. Nucleic acids are substances that can intercalate with DNA or block enzymes that are necessary for DNA replication [7].

8. CONCLUSION

Since they are effective against a range of bacteria including Gram-positive bacteria such as *S. aureus*, *B. cereus*, and *Listeria monocytogenes*, and gram-negative bacteria such as *S. enterica*, *E. coli*, and *P. aeruginosa*, rosemary and lemongrass extracts can be used. Research has shown that the antibacterial potential of rosemary extract is effective on both Gram-positive and Gram-negative species. Compounds rosmarinic acid and carnosic acid found in rosemary are suspected to exhibit antibacterial activity. In the same manner, lemongrass extract is effective against both Gram-positive and Gram-negative bacteria, including *S. enterica* and *B. cereus*. The high concentration of citral in lemongrass can be seen as the main source of the antibacterial properties. Moreover, it has been proved that the antibacterial effect of certain bacteria is improved by the synergistic effect of the combined extracts of lemongrass and rosemary.

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Conflict of interest

The authors declare that they have no conflict of interest.

Ethical Approval

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Author contributions

Arjwan M. Al-Zubaidi: Investigation; Methodology; Project administration; Resources; Supervision; Validation; Roles/Writing - original draft; and Writing - review & editing.

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Riam Sabah Abbood. Conceptualization, Data curation, and Formal analysis, Writing - review & editing.

6. REFERENCES

- [1] **Hussen N, Nabeel Z.** (2018) Antimicrobial Effects of *Mentha pulegium* Extract against *Staphylococcus aureus* Bacteria. *Al-Mustansiriah J Sci* 29: 63-68. doi.org/10.23851/mjs.v29i2.155
- [2] **Tajkarimi MM, Ibrahim AS, Cliver O.** (2010) Antimicrobial herb and spice compounds in food. *Food Control* 21(9):1199-1218. doi.org/10.1016/j.foodcont.2010.02.003
- [3] **Hanon NA, Abd FN.** (2021) The Antimicrobial Activity of *Quercus Infectoria* Extracts Against Bacteria Isolated from Wounds Infection. *Al-Mustansiriyah J Sci* 32(1): 1–4. doi.org/10.23851/mjs.v32i1.919
- [4] **Yap PS, Yiap BC, Ping HC, Lim SH.** (2014) Essential oils, a new horizon in combating bacterial antibiotic resistance. *Open Microbiol J* 8:6-14. doi.org/10.2174/1874285801408010006 . PMID: 24627729; PMCID: PMC3950955.
- [5] **de Souza EL.** (2016) The effects of sublethal doses of essential oils and their constituents on antimicrobial susceptibility and antibiotic resistance among food-related bacteria: A review. *Trends Food Sci Technol* 56:1-12. doi.org/10.1016/j.tifs.2016.07.012
- [6] **Kurniawan MF, Irawan MI, Prakoso A, Sugihartini N.** (2020). Antiinflammatory activity effect of *Ficus carica* and *Ziziphus mauritiana* leaves. *Int J Pharm Res* 12(1): 920-927. doi.org/10.31838/ijpr/2020.12.01.175 .
- [7] **Parveen A, Subedi L, Kim HW, Khan Z, Zahra Z, et al.** (2019) Phytochemicals Targeting VEGF and VEGF-Related Multifactors as Anticancer Therapy. *J Clin Med* 8(3):350. doi.org/10.3390/jcm8030350 . PMID: 30871059; PMCID: PMC6462934.
- [8] **Kaptanoglu AF, Yuksel O, Ozyurt S.** (2012) Plantar pitted keratolysis: a study from non-risk groups. *Dermatol Reports* 4(1):e4. doi.org/10.4081/dr.2012.e4 . PMID: 25386314; PMCID: PMC4212664.
- [9] **Stollsteiner S, Chung S, Laganier J, Tan A, Brun C, et al.** (2016) A story of hands and smelly feet. *Eur Geriatr Med* 7:100–101. doi.org/10.1016/j.eurger.2015.11.007 .
- [10] **Dhitavat J, Bussaratid V, Choovichian V, Tunyong W, Chanket P.** (2012) Pitted keratolysis during flooding in Thailand. *Int J Infect Dis* 16:e217. doi.org/10.1016/j.ijid.2012.05.812 .
- [11] **Leung AK, Barankin B.** (2015) Pitted keratolysis. *J Pediatrics* 167(5): 1165. doi.org/10.1016/j.jpeds.2015.07.056 .
- [12] **Adhikary K, Banerjee P, Barman S, Bandyopadhyay B, Bagchi D.** (2024) Nutritional Aspects, Chemistry Profile, Extraction Techniques of Lemongrass Essential Oil and It's Physiological Benefits. *J Am Nutr Assoc* 43(2):183-200. doi.org/10.1080/27697061.2023.2245435

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