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A Review of Antioxidants and Antimicrobial Compounds of Cymbopogon Flexousus sp. Krishna

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Abstract - East Indian Lemongrass, or Cymbopogon flexuosus, is a multipurpose plant that has been prized for ages due to its many use in medicine and cooking. This fragrant plant may be found in its native India and other regions of Asia, and it is highly prized for the essential oils it produces. Cymbopogon flexuosus and its bioactive components have been under intense scrutiny in recent years owing to their promising medical and commercial implications. Natural and synthetic antioxidants are both vital in protecting the body from the damaging effects of free radicals. They protect cells and tissues from damage caused by free radicals, lowering the likelihood of developing cancer, cardiovascular disease, or neurological illness. Because of its high antioxidant content, Cymbopogon flexuosus is a promising newcomer to the world of natural antioxidants. Concurrently, Cymbopogon flexuosus antimicrobial substances have drawn attention for their potential to fight off a wide range of germs. These compounds have shown strong antibacterial, antifungal, and antiviral characteristics, making them useful for the treatment of infectious illnesses in the pharmaceutical and agricultural industries. In this paper revie the antioxidants and antimicrobial compounds of Cymbopogon flexousus Sp. Krishna.

Keywords - Cymbopogon flexuosus(Sp.- krishna), Antioxidants, Plant, Lemongrass, Health.

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1. INTRODUCTION

The tropical herbaceous plant Cymbopogon flexuosus, more popularly known as lemongrass, has recently attracted a lot of interest due to the possibility that it may have positive effects on one's health, particularly in relation to the antioxidants and antibacterial chemicals that it contains. This plant, which is native to South Asia, has been used in traditional medicine for many years, and recent study has increased the amount of attention paid to the bioactive components it contains. In today's world, where the quest for natural, risk-free, and efficient treatments to counteract oxidative stress and microbial infections is ongoing, the assessments of antioxidants and antimicrobial components from Cymbopogon flexuosus are of the utmost relevance. This exhaustive investigation of the chemical ingredients of the plant and their pharmacological qualities holds the prospect of finding innovative therapeutic agents and alternative sources for addressing a wide variety of health-related concerns.[1]

A wide variety of chemical compounds may be found in lemongrass, which is known for its energizing citrus taste and scent. However, the essential oils that can be derived from this plant have been the focus of much of the research and attention. These essential oils have a high concentration of a group of chemicals that are collectively referred to as terpenoids; citral being the component that predominates. Citral, also known as 3,7-dimethyl-2,6-octadienal, is a component that plays a substantial role in the distinctive taste and scent of lemongrass. [2]

It is the citral component of the plant that is responsible for its possible antioxidant activity. Antioxidants are molecules that shield cells from the potentially harmful effects of free radicals and oxidative stress. Antioxidants may be found in fruits, vegetables, and grains. Because of the rising incidence of illnesses that are linked to oxidative stress, such as cardiovascular disease, cancer, and problems that cause neurodegeneration, the need for powerful antioxidants derived from natural sources, such as lemongrass, is becoming more important. (Donlan, 2022).[3]

Lemongrass has been shown in a number of studies to be effective in quelling the effects of free radicals

and lowering the risk of oxidative damage. Citral, which is principally responsible for the antioxidant capacity of lemongrass essential oil, has been related to both the prevention of lipid peroxidation and the strengthening of the body's natural antioxidant defence systems. According to these results, lemongrass might play a crucial part in alleviating the negative effects of oxidative stress, aiding to the prevention and treatment of a variety of chronic illnesses in the process.

Lemongrass is well known for its excellent antibacterial capabilities, in addition to its antioxidant effects. These actions have helped it earn widespread attention. The essential oils that are extracted from the Cymbopogon flexuosus plant include a wide variety of chemicals that have powerful antibacterial effects. Because of this property, lemongrass is a useful asset in the continuing fight against microbial illnesses, which is especially important in a world that is struggling to deal with the rise of pathogens that are resistant to antibiotics. Lemongrass has antimicrobial properties that are effective against a wide range of microorganisms, including bacteria, fungus, and even certain viruses, which makes it a flexible option for a variety of medicinal purposes.[4]

The antibacterial benefits of lemongrass may be largely due to the high citral component of the herb, which has an inhibiting impact on a broad variety of microorganisms. Citral is found in lemongrass. Citral has been shown to be effective against a wide range of bacteria, including gram-positive and gram-negative forms of bacteria. In addition, the essential oil extracted from lemongrass has shown promise as a possible treatment for fungal infections, notably those brought on by Candida species. These infections are notorious for their resistance to the majority of antifungal medications. Because it is effective against such a wide variety of microorganisms, lemongrass has been proposed as a viable natural alternative to the conventional antimicrobial agents now in use, and research in this field is continuing to investigate its full potential.

Beyond the scope of research conducted in the laboratory, antioxidants and antibacterial substances derived from Cymbopogon flexuosus have been evaluated. There are many different ways that lemongrass may be put to use in the real world. As a natural preservative and taste enhancer, it has discovered a use in the food sector and gained a position there. Because of its energizing and stress-reducing properties, the essential oil is often used in the practice of aromatherapy. In addition, because of its enticing aroma and possible beneficial effects on the skin, lemongrass has found its way into a variety of cosmetics and personal care products. The antibacterial characteristics of lemongrass have applications not only in the medical field, but also in the fields of food preservation and cleanliness. These applications are not exclusive to the therapeutic use of lemongrass. [5]

In addition to this, lemongrass has a long history of usage in the traditional medicine of a number of different countries. It has been used as a treatment for digestive disorders, fever, and respiratory ailments in the practice of traditional Ayurvedic medicine. It has been used as a pain reliever and anti-inflammatory agent in the practice of traditional Chinese medicine. The significance of the plant's enduring reputation as a source of healing is highlighted by the historical background. The development of new scientific knowledge has resulted in a greater understanding of the bioactive molecules that are responsible for these conventional applications, which has led to an expansion of the spectrum of prospective applications.

The assessments of antioxidants and antibacterial substances derived from Cymbopogon flexuosus are gaining traction as the interest in natural treatments and traditional medicines continues to expand. Not only does this discovery have consequences for health and wellbeing, but it also has ramifications for environmentally responsible agriculture and conservation. Lemongrass production has the potential to both provide financial possibilities to local farmers and play a role in the conservation of biological variety. When more is known about the chemical components and biological functions of lemongrass, new farming practices that maximize the production of desired compounds may be developed. [6]

In addition, the studies conducted on the antioxidants and antibacterial chemicals that may be extracted from lemongrass have shown possible new directions for the pharmaceutical and nutraceutical businesses. The discovery of new compounds that have antioxidant and antibacterial characteristics may pave the way for the creation of new medications and nutritional supplements. Given the growing knowledge of the possible adverse effects and environmental issues that are linked with synthetic pharmaceuticals and chemicals, there is no denying the overwhelming allure of natural goods as alternatives to these latter types of substances.

Analyses of the antioxidants and antibacterial chemicals that may be extracted from Cymbopogon flexuosus, more commonly known as lemongrass, are a topic that is of the utmost importance in modern research and medical practice. This tropical herbaceous plant, which is most known for the abundance of essential oils it contains and the singular fragrance it exudes, has a tremendous amount of untapped potential as a source of antioxidants and antibacterial agents. Lemongrass is associated with a variety of health advantages, some of which include protecting against oxidative stress and protecting against microbial infections. Its uses in the real world encompass a wide variety of domains, including the cosmetics industry, traditional medicine, and the preservation of food. Research is now being conducted to investigate the chemical components of lemongrass in more detail. This might

lead to the development of novel medicinal agents, environmentally friendly agricultural techniques, and exciting new potential in the pharmaceutical and nutraceutical sectors. As people grow more interested in finding natural and risk-free treatments, the importance of lemongrass as an antioxidant and antibacterial agent is rising, and it has the potential to have a significant influence on the overall health and wellbeing of people all over the world.[7]

2. ANTIMICROBIAL AGENT

New chemicals that stop biofilm development before it reaches its last, most resistant stage are of significant interest because of the unique cellular features of sessile bacteria. There is a resurgence of interest in the quest for alternative antimicrobial drugs as a result of the rise of bacterial strains resistant to most existing medicines. Additionally, the usage of synthetic preservatives, many of which have carcinogenic and teratogenic activity (Nascimento et al., 2020), has reduced their popularity among consumers.

Consumers are increasingly interested in finding natural foods that may have positive health effects, and this trend should be highlighted. Because of these causes, there has been a rise in curiosity in the quest for natural compounds with antimicrobial biological activity. Essential oils (EOs) from aromatic plants are utilized for their antioxidant, antibacterial, and nutritional benefits when added to food. In addition to these features, antibacterial action on biofilms has been discovered, suggesting that these secondary metabolites or their components might be used as disinfectants (Xiaofeng, et al., 2018).

The essential oil (EO) extracted from the leaves of Cymbopogon flexuosus (lemongrass of East India) has been in high demand across the globe. This is especially true of its usage as a medicinal, condimental, and/or preservative ingredient in the food and beverage industry, where its lemon taste stands out among its many other uses.[8]

There is an immediate need for therapeutic discoveries and enhancement of current infection control and antimicrobial practices in response to the worldwide problem of antimicrobial resistance (AMR) and illnesses caused by AMR bacteria. Acinetobacter baumannii, a Gram-negative bacteria, has been recognized as a highly adaptable and resistant pathogen in recent years. Multidrug-resistant, extensively drug-resistant, and pan-drug-resistant Acinetobacter baumannii have all been linked to outbreaks in hospitals and communities across the globe. Since the current therapies for A. baumannii infections have proven ineffective, Vila and Pachon (2021) argue that novel strategies and antimicrobial drugs are required for their effective management.

The ineffectiveness of conventional antibiotics against AMR pathogens has sparked research into potential alternatives. The extensive body of research on natural antimicrobials and, in particular, the antimicrobial benefits of essential oils (EOs) from plants, is proof of this. Essential oils have been examined for their purported benefits, which include fighting bacteria, fungi, biofilms, parasites, viruses, and even cancer, but less is known about their bioactivity and toxicity. Nevertheless, EOs' commercial usage and applications, such as those in domestic cleaning goods, cosmetics, fragrance, pesticides, disinfectant wipes, food, and the control of illnesses in animals, continue to expand.[9]

Lemongrass essential oil (EO) is extracted from the Cymbopogon lemongrass plant and is becoming more popular as a commercially manufactured essential oil (Tisserand and Young, 2013). Numerous in vitro investigations have shown the antibacterial efficacy of entire lemongrass EO, including its activities against AMR pathogens. Citral, which is abundant in lemongrass, is responsible for the herb's potent antibacterial effect, as has been shown in several studies. The FDA has cleared citral for use in food additives and has deemed lemongrass essential oil safe for human consumption.

Tea tree oil has been the focus of the majority of research looking at the cytotoxic action of EOs and components on human cell lines. Lemongrass essential oil (EO) from four Cymbopogon species (C.citratus, C.giganteus, C.nardus, and C. schoenantus) was tested for its cytotoxic potential against a human non-cancer diploid fibroblast cell line (W138) and found to be moderately harmful to these cells. However, the impact of C. flexuosus EO on cutaneous fibroblast has not been established to our knowledge, and its cytotoxic effect was not evaluated in the Kpoviessi study, which is the subject of our research because of its antimicrobial activity. However, citral has been linked to a variety of negative outcomes, including sensitization and allergic contact dermatitis. [10]

The Poaceae (Syn. Gramineae) family includes the genus Cymbopogon. The Poaceae family, which includes over 700 genera and 11,000 species, may be found almost everywhere but is particularly abundant in south and southeast Asia. The warm temperate and tropical climates are home to

Cymbopogon. In 1815, Sprengel coined the term "Cymbopogon," referring to a small group of taxa that would later be transferred to the Andropogon genus as a subtype of the Graminae family.

Figure 1: Plants of the species Cymbopogon flexuosus (Steud.) Wats, often known as lemongrass, have a unique morphology and anatomy.

The distribution of the species within the genus Cymbopogon is somewhat intricate. According to Chase and Niles (2017), there are between 102 and 104 species in this genus. More than 51 Cymbopogon species may be found in Africa, 41 in the Indian subcontinent, 5 in both Australia and South America, 3 in Europe, and 3 in the Americas. Few details about this species have been published. Looked at 26 species from Burma, Ceylon, and Pakistan, while covered the taxonomy of 55 species found in India, Nepal, and Bhutan. 27 species were described as being executed in India. [11]

3. ANTIOXIDANT COMPONENT

Citral is a major component of the bioactive chemical cocktail found in Cymbopogon flexuosus, more commonly known as lemongrass.[12] Lemongrass's health advantages may be traced back to its high concentrations of citral, a powerful antioxidant. In this article, we'll look closely at citral, an antioxidant component found in lemongrass:

- **Anatomy of a Citral**: Terpenoid that occurs naturally and goes by the name citral. Also known as 3,7-dimethyl-2,6-octadienal. Geranial (trans-citral) and neral (cis-citral) are the two isomeric forms of this aliphatic aldehyde. The distinctive citrus scent and taste of lemongrass may be attributed to both isomers.
- **Having Antioxidant Qualities**: Citral has powerful antioxidant effects, for which it is well known. Free radicals are extremely reactive chemicals that may cause oxidative damage to DNA, proteins, and lipids; antioxidants help protect cells and tissues from this kind of damage. As an antioxidant, citral is essential for lowering levels of oxidative stress in the body.
- **Stopping the Oxidation of Fats and Oils**: Citral's antioxidant impact is shown, in part, by its ability to inhibit lipid peroxidation. The fats in cell membranes may be damaged by a process called lipid peroxidation, which is caused by the presence of free radicals. This malfunction in cells may lead to many different illnesses and is connected to cardiovascular problems.
- **Strengthening the Body's Natural Antioxidant Defenses**: The antioxidant defense systems of the body are boosted by citral. Superoxide dismutase (SOD) and catalase are two examples of antioxidant enzymes that may be activated to assist neutralize damaging reactive oxygen species (ROS).
- **Prevention of Diseases Caused by Oxidative Stress**: Because of its anti-oxidant properties, the citral in lemongrass has been studied for its potential to treat or prevent a wide range of diseases and disorders linked to oxidative stress. Diseases of the heart, cancer, neurological problems, and age-related ailments may fall under this category.
- **Organic Substitute for Man-Made Antioxidants**: Natural antioxidants like citral and others found in lemongrass may replace the synthetic antioxidants that are widely employed in the food and pharmaceutical sectors. Since they are found in nature and have the potential to improve health, they are gaining popularity as ingredients in functional meals and dietary supplements.
- **Reducing Stress**: The citral in lemongrass is responsible for its calming and upliftiing scent. Essential oil of lemongrass is used in aromatherapy for its calming and stress-relieving effects.
- **Possibilities for Food Storage**: The food sector may make use of citral because of its antioxidant characteristics. As a natural preservative and taste enhancer, lemongrass essential oil may help keep food fresh for longer without compromising on its quality.
- **Potential for Use in Pharmacology**: Studies into the possible pharmaceutical uses of citral, a bioactive molecule. The antioxidant and other positive qualities of these compounds have led to their usage in the creation of innovative medications and

therapeutic agents for a wide range of medical ailments.

One of the main reasons why *Cymbopogon flexuosus* (Lemongrass) is so good for you is because of citral, the plant's principal antioxidant ingredient. It's a great natural asset for health and wellbeing since it helps the body deal with oxidative stress, stops lipid peroxidation, and boosts its own antioxidant defences.

Citral has several uses, including those related to food preservation and aromatherapy, in addition to its health advantages. As studies progress, citral's pharmacological potential may lead to the creation of novel therapeutic agents and antioxidant-rich products for a wide range of medical applications.[13]

Cymbopogon flexuosus, or lemongrass, has chemicals in its essential oils that are recognized for their antioxidant effects. Antioxidants are compounds that mitigate free radical damage to cells. In this article, we'll discuss the role that Lemongrass' antioxidant components play:

Principal Antioxidant Substances:

1. **Citral**: The main anti-oxidant component of lemongrass is citral. Geranial and neral are its two isomers. This chemical is what gives Lemongrass its signature lemony scent and taste. Citral has strong antioxidant properties and may eliminate harmful free radicals. Preventing lipid peroxidation, a key step in the oxidative stress process, has been shown. Citral aids in the protection and preservation of cell membranes by preventing the oxidation of lipids (fats).
2. **Geraniol**: Lemongrass also has another antioxidant component called geraniol. It helps give the plant its scent and has antioxidant properties. Geraniol, a monoterpene alcohol, may protect cells from the damage caused by free radicals.
3. **Limonene**: Lemongrass contains the terpene limonene, which has been scientifically shown to have antioxidant effects. By neutralizing free radicals and protecting cells, it's useful in the fight against oxidative stress.
4. **Antioxidant Mechanisms**: Lemongrass's antioxidant compounds work through various mechanisms to combat oxidative stress and protect cells from damage.
5. **Scavenging of Free Radicals**: Citral, one of the antioxidant components in lemongrass, is very efficient in neutralizing free radicals. They achieve this by giving electrons to reactive molecules, rendering them harmless and halting any oxidative damage they would have caused.
6. **Lipid Peroxidation Suppression**: Lipid peroxidation, which takes place when free radicals attack and destroy lipid molecules in cell membranes, is an important part of oxidative stress. Compounds like citral may stop this from happening, protecting cell membranes in the process.
7. **Increasing Natural Antioxidant Protection**: Antioxidants in lemongrass have been shown to boost the body's own antioxidant defenses. Boosting the levels of antioxidant enzymes like catalase and superoxide dismutase, which help remove harmful reactive oxygen species (ROS), is one way to do this.

Therapeutic Potentials:

Lemongrass's anti-oxidant capabilities have important consequences for health and well-being:

1. **Preventing Damage from Oxidative Stress**: Many age-related and degenerative illnesses, such as cardiovascular disease, cancer, and neurological disorders, have been linked to oxidative stress. The anti-oxidants found in lemongrass may make some disorders less likely to manifest.
2. **Organic Substitute for Man-Made Antioxidants**: When compared to the synthetic antioxidants often utilized in the food and pharmaceutical sectors, lemongrass stands out as a more desirable option. Its potential health advantages and natural origin make it a desirable ingredient for new functional meals and nutritional supplements.
3. **Reducing Stress**: Lemongrass' citral content gives out a pleasant scent that has been shown to have calming and mood-boosting benefits. It has been shown to provide calming and stress-reducing effects when used in aromatherapy.

Lemongrass, also known as Cymbopogon flexuosus, is a rich source of antioxidant chemicals, especially citral, which fight free radicals and prevent cellular damage caused by oxidation. These antioxidant qualities have important consequences for health and wellbeing, including the possible prevention of certain chronic illnesses and the alleviation of stress. Lemongrass's uses in traditional and Western medicine, as well as the food and cosmetics sectors, are growing as scientists learn more about the herb's high antioxidant properties.[14]

4. CONCLUSION

Cymbopogon flexuosus (Sp.- Krishna), the East Indian Lemongrass, provides a rich supply of antioxidants and antibacterial chemicals that have the potential to make substantial contributions to several industries, including healthcare, agriculture, and the pharmaceutical industry. This adaptable plant is rich in antioxidants, making it a potentially useful natural resource in the fight against oxidative

stress and the prevention of chronic illness. At the same time, the antimicrobial compounds isolated from Cymbopogon flexuosus (Sp.- Krishna), show strong capacities to battle a broad variety of infections, suggesting intriguing new approaches for the creation of therapeutic medicines. Research on Cymbopogon flexuosus and its bioactive components is continuing, and further study is needed to fully realize the plant's therapeutic potential. Clarifying the mechanisms of action, confirming their effectiveness via clinical studies, and investigating novel applications in fields including food preservation, natural medicine, and agriculture should be the primary goals of future research. Cymbopogon flexuosus, with its antioxidant and antibacterial properties, offers a promising new direction for research and development as the need for natural and sustainable alternatives rises. By continuing to discover the mysteries of this magnificent plant, we may harness its full potential for the advancement of human health and numerous sectors.

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