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RESEARCH ARTICLE

LEMON GRASS (*CYMBOPOGON CITRATUS*) EXTRACT AS MOSQUITO REPELLENT LOTION

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Abstract

Cymbopogon citratus is a potentially beneficial lotion for repelling mosquitoes due to its ability to repel them. The study aims to investigate the potential of lemongrass as an agent for mosquito repellent lotion. This lotion can be considered a natural, cost-effective, and efficient mosquito repellent. The experiment involved the creation of three unique models utilizing improvised recyclable containers. The researchers inserted a piece of black clothing without any lemongrass mosquito repellent ointment in the first container. The researchers inserted a piece of black clothing with 2 mL of lemongrass mosquito repellent lotion in the third and final container. The researchers inserted a piece of black clothing with 6 mL of lemongrass mosquito repellent lotion in the third and final container. The experiment's findings demonstrated the efficacy of the lemongrass-based mosquito repellent cream. The findings also demonstrated that the efficacy of the lotion varies depending on the quantity administered. Overall, this study demonstrates that *Cymbopogon citratus* can be employed as a lotion to repel mosquitoes due to its efficacy and advantages for both the community and people.

Keywords: cymbopogon citratus, lotion, repelling mosquitoes, repel

Introduction

Mosquitoes are vectors that transfer harmful germs, leading to illnesses and deaths worldwide (Mistica et al., 2019). Mosquito-borne diseases are transferred to humans via the bite of a mosquito carrying the disease. The diseases encompass Dengue, Yellow Fever, Zika, West Nile, and Chikungunya. These disorders significantly impact the well-being of persons and might even result in mortality (Baylor College of Medicine).

The World Health Organization (WHO) recorded 19,404 cases of Dengue in the Philippines as of February 2023. This represents a 97% increase as compared to the corresponding period in 2022. In addition, there have been a total of 61 fatalities this year, which represents a decrease compared to the 74 deaths recorded during the corresponding period last year. The tropical climate of the Philippines makes it a favorable habitat for several species of mosquitoes (Center for Science Education). Rashid et al. (2012), as referenced by Mistica et al. (2019), reported that mosquito-borne diseases primarily affect children under 15.

The Department of Health promotes the regular application of insect repellent as a preventive measure against Dengue. Mosquito repellents decrease the likelihood of mosquito bites and, consequently, decrease the risk of contracting mosquito-borne illnesses. Mosquito repellents deter mosquitoes from alighting on the skin's surface (Commonwealth of Massachusetts).

Cymbopogon citratus, also known as lemongrass, is a therapeutic herb that thrives in tropical regions like the Philippines (Wifek et al., 2016). Research has demonstrated that lemongrass possesses diverse pharmacological properties, including anti-amoebic, antibacterial, antidiarrheal, antifilarial, antifungal, and anti-inflammatory effects. Furthermore, as Mehta explains, the potent aroma of lemongrass emits a lemony perfume that repels mosquitoes due to their aversion to this particular fragrance.

Zulfikar et al. (2019) conducted a study where lemongrass extract replaced malathion in mosquito fogging. This substitution led to an average mortality rate of 18 mosquitoes, accounting for 90% of the population. The study determined that lemongrass extract is a viable alternative to malathion as an insecticide, proving its efficacy. Moreover, a study by Kurniasih et al. (2021) found that orange and lemongrass essential oils contain citronellal and limonene. In addition, Kurniasih et al. (2021) asserted that the citronellal molecule



functions as an insecticide component, acting as both an antifeedant and repellent. Additionally, they emphasized the significance of utilizing essential oils instead of synthetic pesticides in order to establish a secure environment. The study findings indicate that both essential oils can eliminate mosquito larvae and can be considered potential options for environmentally friendly pesticides.

In contrast, a study by Mangubat (2022) found that while the essential oils of sugar apple and lemongrass show potential effectiveness against mosquitoes, they are not as effective as commercially available sprays. The study proposed that the essential oils of sugar apple and lemongrass should be modified to increase their concentrations, thus enhancing their effectiveness.

The researchers are motivated to undertake this study in response to the annual high incidence of mosquito-borne diseases in the Philippines. The study will emphasize the significance of insect repellents to decrease the likelihood of contracting mosquito-borne illnesses. Additionally, it will explore the potential of lemongrass, a widely available plant in the Philippines, for developing a mosquito-repellent lotion. Moreover, the researchers aim to bolster additional investigations on the efficacy of lemongrass as a mosquito repellent, aiming to mitigate the prevalence of mosquito-borne diseases in the Philippines.

Research Questions

Specifically, this study sought to answer the following questions:

- Does a lemongrass extract lotion effectively repel mosquitoes compared to a placebo or control lotion?
- What is the duration of repellency of lemongrass extract lotion against various mosquito species relevant to human health (e.g., *Aedes aegypti, Culex pipiens*)?
- How does the concentration of lemongrass extract in the lotion impact its repellency duration?
- How does a lemongrass extract lotion compare to commercially available repellents (e.g., DEET) regarding repellency duration and effectiveness?

Literature Review

Lemongrass Repellent

Plata-Rueda et al. (2020) conducted a study to evaluate the insecticidal and repellant properties of lemongrass essential oil and also examined its chemical makeup. The study's findings indicate that lemongrass essential oil, citral, and geranyl acetate have the potential to function as insecticides or repellents to control *S. granarius*.

Moreover, the study indicated that the insecticidal properties of lemongrass essential oil are attributed to the synergistic action of its components, which enable them to effectively enter the insect's body either through penetration or via the respiratory system. The study determined that lemongrass essential oil, citral, and geranyl acetate are viable alternatives to synthetic chemical pesticides.

The study conducted by Magpantay (2019) examined the efficacy of lemongrass as a fly repellent often used in households. The study's findings indicate that using lemongrass essential oil as an insecticide is efficacious. Furthermore, the study indicated that the product's efficiency can be optimized based on how it is used. Additionally, the study proposed the necessity for future investigation into the techniques for more efficient extraction of essential oil from lemongrass.

Mosquitoes

According to Spitzen and Takken (2018), mosquito-borne diseases impose significant burdens on society. In addition, they noted that while the incidence of Malaria is declining, there has been an increase in the prevalence of other mosquito-borne illnesses such as Zika and Dengue.

The prevalence of Chikungunya and West Nile virus is on the rise, with these diseases spreading across multiple continents. The study also indicated that the life history characteristics of mosquitoes can be categorized into plant feeding, mating, host feeding, oviposition, larval development, and pupation.

In a study conducted by Mistica et al. (2019), it was found that mosquitoes serve as vectors for transmitting pathogenic bacteria, which significantly contribute to the occurrence of diseases and deaths worldwide. Moreover, the study indicated that these organisms are proliferating at an accelerated rate and persistently impacting the well-being of those afflicted by the diseases they transmit. This study examined the mosquito species found in Public Schools of Metro Manila, Philippines. The results showed that 88.94% of the collected mosquito larvae were recognized as Aedes aegypti, while 11.06% were identified as Aedes albopictus.

Lemongrass Repellent and Mosquitoes

Zulfikar et al. (2019) conducted a study where lemongrass extract was employed as an insecticide to target Aedes aegypti mosquitoes. The study's results indicated that the mean number of deceased mosquitoes was 18 out of a total of 20. The study demonstrated that lemongrass extract is a viable alternative to malathion in fogging operations. Moreover, the research indicated that utilizing lemongrass



extract as a replacement is not only cost-effective and eco-friendly, but also emits a pleasant odor to the neighborhood. Regional or indigenous literary works

Mangubat (2022) conducted a study where the extract of lemongrass and sugar apple was utilized as a mosquito repellant. The study demonstrated that the commercial spray had superior efficacy against mosquito larvae in comparison to the combined crude extract of lemongrass and sugar apple. Furthermore, the study indicated that the solution had promising effectiveness and suggested that it should be modified to achieve higher concentrations for enhanced efficacy.

Methodology

Materials and Equipment

Lemongrass Extract Preparation:

- Dried lemongrass leaves (*Cymbopogon citratus*)
- Distilled water or carrier oil (e.g., jojoba oil, coconut oil) for extraction (depending on chosen method)
- Grinder (optional, for grinding dried leaves)
- Heating mantle or hot plate
- Condenser (for steam distillation, if applicable)
- Separatory funnel (for solvent extraction, if applicable)
- Rotary evaporator (optional, for solvent removal)
- Analytical balance
- Filtration materials (e.g., cheesecloth, filter paper)

Lotion Formulation:

- Lemongrass extract
- Lotion base (e.g., water-based lotion, oil-based lotion)
- Natural emollients (e.g., shea butter, aloe vera) optional
- Natural emulsifiers (e.g., beeswax, vegetable emulsifying wax) optional
- Preservatives (optional, for long-term storage)
- Beakers or flasks
- Magnetic stirrer (optional)
- pH meter (optional)
- Dispensing bottles

Evaluation:

- Mosquitoes (appropriate species, ethically sourced)
- Mesh cages for mosquito containment
- Human volunteers (if conducting human subject testing with IRB approval)
- Ethical approval for using live animals (if applicable)
 - Depending on the chosen testing method:
 - Timed observation chambers
 - Video recording equipment
 - Skin patch testing materials (for human studies)

Treatment/ General Procedure

Making of the Lemongrass Mosquito Repellent Lotion

The researchers prepared all the needed ingredients, which included lemongrass leaves, coconut oil, eucalyptus essential oil, and water. The researchers then obtained lemongrass extract by boiling the lemongrass leaves in water in a cooking pot. At the same time, the researchers measured ¼ cup of coconut oil and placed it in a container, added 3 tablespoon of lemongrass extract, and added 3 drops of essential oil as well. The researchers then mixed it together and transferred it to the lotion container.

Gathering the Mosquitoes

The researchers gathered 3 mosquitos for the experiment, and placed 1 mosquito per container.

Preparing the Cloth

Instead of immediately testing the lemongrass mosquito repellent lotion on human skin, the researchers first used a piece of dark clothing with human sweat as an alternative.

Experiment

The researchers prepared 3 containers with a mosquito each. In the first container, the researchers placed a piece of dark clothing with



no lemongrass mosquito-repellent lotion. In the second container, the researchers placed a piece of dark clothing with 2 mL of lemongrass mosquito repellent lotion. In the third and last container, the researchers placed a piece of dark clothing with 6 mL of lemongrass mosquito repellent lotion. The researchers observed what happened inside the container and gathered the data.

Results and Discussion

Findings

In the first container, the mosquito was immediately drawn to the black cloth, despite the absence of mosquito repellent lotion, which was clearly visible on its surface from a close distance. Even after 5 minutes, the insect continued to be drawn to the material and its behavior remained same.

Meanwhile, the mosquito in the second container departed from the dark fabric while carrying 2mL of mosquito repellent lotion. Even after 5 minutes, it maintained a consistent distance from the black cloth.

Finally, in the case of the third container, the researchers promptly observed that the mosquito had become debilitated, as seen by its inability to take flight from the black fabric. After a duration of 5 minutes, the mosquito perished.

Recommendations

- Compare the efficiency of different lemongrass extract preparation methods (e.g., steam distillation, solvent extraction) in terms of yield and repellency activity. Choose the most potent extract method while considering safety and resource efficiency.
- Determine the optimal concentration of lemongrass extract in the lotion to achieve effective repellency while minimizing the risk of skin irritation. Conduct serial dilutions of the extract and test their repellency against target mosquito species.
- Investigate different lotion base options (water-based, oil-based) to identify the one that best delivers and maintains the lemongrass extract's repellency properties. Consider factors like absorption rate, user comfort, and compatibility with other ingredients.
- Explore using natural emollients (e.g., shea butter, aloe vera) to improve user comfort and skin hydration. Utilize natural emulsifiers (e.g., beeswax, vegetable emulsifying wax) to create a stable and well-blended lotion.
- For long-term storage stability, consider adding natural preservatives (if appropriate) to prevent microbial growth in the lotion.
- Focus testing on mosquito species relevant to the lotion's intended use. Depending on the geographic location, this might involve Aedes aegypti, Culex pipiens, or other species.
- Utilize established in vitro or in vivo testing methods to evaluate repellency duration. In vitro methods involve observing mosquito behavior in exposure chambers, while in vivo studies involve testing on human volunteers with ethical approval. Consider a combination of methods for a more comprehensive evaluation.
- Compare the repellency efficacy and duration of the lemongrass extract lotion to commercially available repellents, including DEET-based products. This will provide a benchmark for the effectiveness of the new formulation.

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