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Research Paper

Mimosa pudica (makahiya) with cucumber melon-infused fragrance: a natural air freshener gel and mosquito repellent

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ABSTRACT

Insect repellents commonly contain most ingredients such as: DEET, Picaridin, IR3535, and Oil of Lemon Eucalyptus, thus becoming a common product for manufacturers to manufacture. Insect repellents enable people to feel comfortable and guarded as they have a purpose of repelling insects especially mosquitoes when spending time outdoors or posed on an area with high populations of insects or mosquitoes. Without insect repellents, people would suffer with insect problems, hence, the researchers utilized an eco-friendly and accessible primary ingredient for mosquito repelling and air freshening, which is the Mimosa pudica. With the sulfuric odor or compound present in the plant it can repel mosquitoes. To counteract the sulfuric odor, a cucumber melon fragrance was infused, providing a refreshing aroma that enhances its usability as an air freshener while maintaining its repellent efficacy. The purpose of this research was to establish the effectiveness of Mimosa pudica extract in air purification as well as mosquito repellent ability while giving the product an aromatic character through a fresh cucumber melon fragrance. Phytochemical analysis was done to find active compounds responsible for its repellent activity. This product, based on a standard gel-formulation technique with natural fragrance infusion, was used to assess its odor-neutralizing activity and mosquito-repellent ability. Results of the phytochemical analysis revealed bioactive compounds, including alkaloids, flavonoids, and tannins, responsible for the efficacy of the plant. Fragrance and usability of the product were also tested for consumer acceptance. This study proves the possibility that Mimosa pudica may become the next best thing for ecological, inexpensive substitutes in everyday household products: useful, with aesthetic value, but only using fewer chemical by-products.

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1. INTRODUCTION

Background of the Study

Air fresheners have become essential household products, primarily designed to mask or eliminate unpleasant odors. However, modern air fresheners typically serve a singular purpose: improving indoor scent without considering broader environmental and health impacts. In tropical regions like the Philippines, characterized by frequent rainfall and humidity, the presence of mosquitoes poses a significant health concern. [1] Mosquitoes carry dangerous diseases such as dengue, malaria, and the Zika virus. Despite the availability of numerous mosquito repellents, the market still lacks products that combine odor elimination with insect repelling. This study aims to address this gap by developing a natural, eco-friendly air freshener gel incorporating the repellent properties of Mimosa pudica (Makahiya) with a cucumber melon fragrance [2].

International studies have explored the potential of integrating plant-based ingredients into air fresheners and mosquito repellents [3]. Found that Cymbopogon winterianus (Java citronella oil) contains active compounds like geraniol and citronellal, which effectively repel mosquitoes, particularly Aedes aegypti, the mosquito responsible for transmitting dengue [4]. [5] This research highlights the potential of plant-based oils as sustainable alternatives to chemical insecticides. Another study by examined how synthetic fragrances in air fresheners contribute to indoor air pollution, triggering respiratory issues and allergies [6]. This research emphasizes the need for safer, plant-based alternatives that not only reduce mosquito populations but also improve air quality [7].

National studies have supported the use of Mimosa pudica for mosquito repellent applications. Mondol and showed that Mimosa pudica emits sulfur compounds that repel mosquitoes. [8] This plant has been used in traditional medicine and has demonstrated insecticidal properties, making it an ideal candidate for eco-friendly repellents. [9] The study of found that Mimosa pudica was effective in repelling Cryptolestes pusillus, a known pest. According to da Silva and the plants natural repellent properties have long been recognized, especially in the Philippines, where it is abundant. [10] While traditional uses have focused on incense sticks, incorporating Mimosa pudica into modern products such as air fresheners remains underexplored [11].

Local studies also support the potential of Mimosa pudica as a mosquito repellent. Research conducted in southern Philippines highlighted the effectiveness of Mimosa pudica incense sticks in repelling mosquitoes, confirming its insecticidal properties. Despite these findings, the development of a multi-functional product that combines air freshening and mosquito protection has not been sufficiently addressed. According to many mosquito repellents available in the market are chemical-based and can be harmful to health, degrading indoor air quality and posing risks to vulnerable populations, such as children and the elderly. Therefore, there is a clear need for natural alternatives that can address both mosquito control and air quality improvement.

This study intends to fill this gap by developing an air freshener gel that combines the mosquito-repelling sulfur compounds of Mimosa pudica with a pleasant cucumber melon fragrance. The gel formulation will use a natural gelling agent to provide long-lasting effects. Combining these two functionalities, the air freshening and mosquito repelling into one product will meet the growing demand for environmentally friendly, multifunctional solutions. This research seeks to contribute to the development of products that are both sustainable and effective in improving indoor environments while protecting against mosquito-borne diseases. By using natural ingredients like Mimosa pudica, this study

aims to reduce reliance on harmful synthetic chemicals commonly found in air fresheners and insect repellents. Furthermore, the eco-friendly nature of the proposed gel makes it a safer option for households, particularly in tropical regions where mosquito-borne diseases are a constant threat. The proposed product aligns with global efforts to create healthier, more sustainable consumer goods, offering a natural solution to two common household issues: unpleasant odors and mosquito infestations.

Objectives of the Study

1. To formulate a natural air freshener gel using Mimosa pudica (Makahiya) with cucumber melon fragrance for effective mosquito repellency.
2. To evaluate the mosquito-repellent efficacy of the air freshener gel when tested in a controlled school environment.
3. To assess the long-lasting scent retention and its effectiveness in eliminating unpleasant odors in a classroom setting.
4. To compare the performance of the developed gel against commonly available synthetic air fresheners in terms of mosquito repellency and odor control.

Research Questions

1. How effective is the Mimosa pudica-infused air freshener gel in repelling mosquitoes in a school environment?
2. What is the duration of the mosquito-repelling effect of the air freshener gel in a classroom setting?
3. How does the Mimosa pudica-infused gel compare to synthetic air fresheners in terms of odor elimination and mosquito repellency?
4. Does the cucumber melon fragrance maintain its scent in the air freshener gel over time?

Null Hypothesis

1. The Mimosa pudica-infused air freshener gel has no significant effect on repelling mosquitoes in a school environment.
2. The duration of the mosquito-repelling effect of the air freshener gel is not significantly different from synthetic air fresheners.
3. There is no significant difference in the effectiveness of odor elimination between the Mimosa pudica-infused air freshener gel and synthetic air fresheners.
4. The cucumber melon fragrance does not significantly influence the scent retention in the air freshener gel over time.

Significance of the Study

This study aims to evaluate the efficiency of Mimosa pudica infused with cucumber melon fragrance as a mosquito repellent. The findings will benefit the following groups:

1. **Students and School Communities**: Offering a safe, natural alternative to chemical repellents for protecting against mosquito-borne diseases and improving classroom air quality.
2. **Teachers and School Administrators**: Providing an eco-friendly product to enhance classroom comfort and safeguard student health.
3. **Researchers and Environmentalists**: Contributing to the growing interest in natural, sustainable pest control methods and environmentally friendly air quality improvements.
4. **Households and Families**: Giving families a cost-effective, non-toxic mosquito repellent for healthier living environments.
5. **Local Communities in Tropical Regions**: Offering a practical and affordable solution for communities affected by mosquito-borne diseases.

Conceptual Framework

Shows the process of formulating a non-toxic gel using Mimosa pudica extract and cucumber-melon fragrance. Figure 1 the materials, steps, and results of combining the mosquito-repelling properties

of Mimosa pudica with a refreshing scent. Finally, the final product's effectiveness as a repellent and air freshener is assessed.

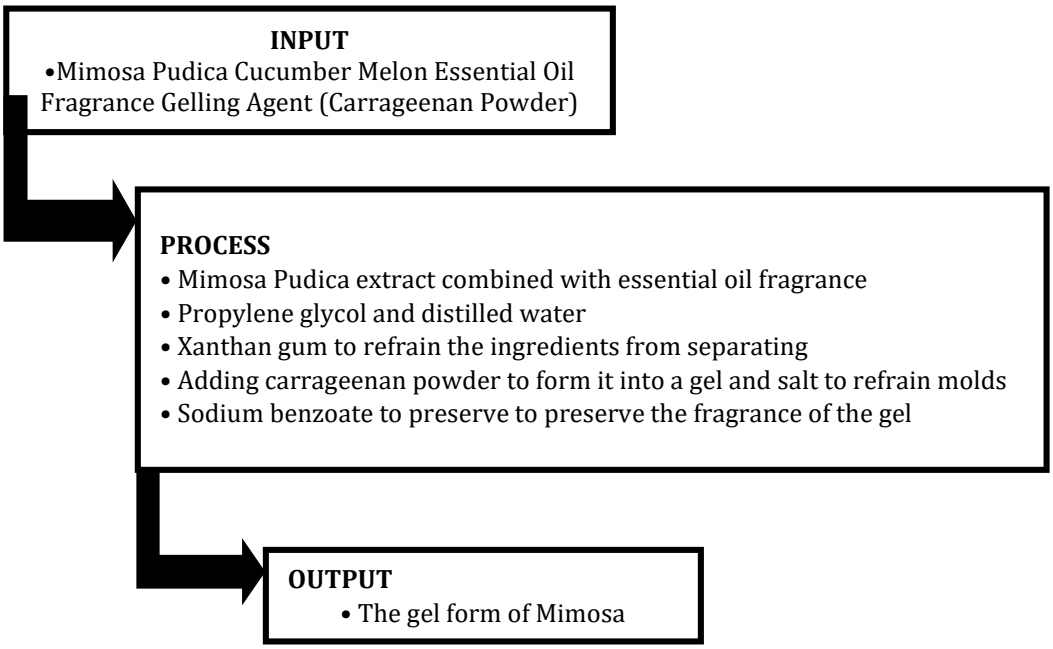

Figure 1. The Research Paradigm

Scope and Limitation

This study evaluates a natural air freshener gel made from Mimosa pudica (Makahiya) infused with cucumber melon fragrance as a mosquito repellent. It will be conducted in a school setting, particularly in classrooms, to assess the gel's effectiveness in repelling mosquitoes and eliminating odors. The research will focus on the gel's impact on mosquito presence and air quality in the classroom, with a sample group of students, teachers, and staff.

The study is limited to a single school in the Philippines, which may restrict its applicability to other regions with different climates or mosquito species. It will only examine the mosquito-repellent and odor-eliminating properties of the gel, without exploring other health benefits or long-term environmental impacts. The study will also be conducted over a short period, focusing on immediate effects. Only one formulation of the gel will be tested, so comparisons with alternative recipes or methods will not be made.

2. RELATED WORK

The study by investigated the mosquito repellent properties of Java citronella oil demonstrating its effectiveness in repelling Aedes aegypti mosquitoes. The researchers extracted the oil using steam distillation and incorporated it into air freshener gels. Their findings showed that the active compounds, geraniol and citronellol, provided 78% and 77% protection against mosquito bites, respectively. Additionally, solution I, which allowed the most controlled release of these compounds, remained effective for up to 16.82 days. This study supports the viability of plant-based mosquito repellents as an environmentally friendly alternative to synthetic products [12].

Examined the impact of synthetic fragrances on indoor air quality, emphasizing the health risks associated with volatile organic compounds (VOCs) commonly found in household products. These compounds, including formaldehyde and benzene derivatives, contribute to respiratory issues and allergies, particularly in enclosed spaces. Called for stricter regulations on VOC levels and advocated for the use of naturally derived alternatives. These findings are relevant to the development of natural air fresheners that double as mosquito repellents, ensuring both efficacy and safety.

Explored the unique mechanosensitive properties of Mimosa pudica roots, which release sulfur-containing compounds upon physical disturbance. This study suggests that the plant's defensive mechanisms could have applications in repelling insects. [13] According to the release of volatile compounds such as propane sulfonic acid may serve as a natural deterrent, highlighting the potential of Mimosa pudica as a bioactive ingredient in mosquito repellents.

Comprehensively reviewed Mimosa genus which revealed its significant pharmacological properties, including antimicrobial, antioxidant, anticancer, antidiabetic, wound-healing, and anti-inflammatory effects. A work of Silva [14]. Indicates that various Species have medicinal potential, though further studies are required to validate their safety and efficacy. This review underscores the broader applicability of Mimosa pudica beyond its mechanical responsiveness, reinforcing its potential as a sustainable ingredient in mosquito repellent formulations [15].

A study on the formulation of a bio-mosquito repellent air freshener gel using Cymbopogon citratus (lemongrass) essential oil demonstrated its efficacy as a natural alternative to chemical repellents. Among the tested formulations, the one containing 5.0% oil showed the highest repellent activity. The research emphasized the environmental benefits of using biodegradable and non-toxic plant-based repellents, which offer a sustainable solution for mosquito control [16].

Ehi-Omosun and examined the protective effects of Mimosa pudica leaf extract against lung injuries caused by exposure to synthetic mosquito repellents in Wistar rats. Their findings revealed that oral administration of the extract significantly mitigated respiratory damage due to its anti-inflammatory and antioxidative properties. However, [17]. Declared that a higher dose of 500 mg/kg resulted in minor adverse effects. This study highlights the potential therapeutic applications of Mimosa pudica, particularly for reducing the health risks associated with chemical-based repellents. A study by [18]. Developed an herbal mosquito repellent finish for cotton fabrics using Anacyclus pyrethrum extracts. The most effective formula achieved a repellency rate between 57.87% and 79.63% under optimal conditions, demonstrating the potential of plant-derived textile treatments in mosquito control. However revealed that the repellency decreased significantly after washing, indicating the need for further research to improve longevity.

The research on Mimosa pudica incense sticks as a mosquito repellent emphasizes the plant's natural repellent properties and its cost-effectiveness, particularly in tropical regions where mosquito-borne diseases are prevalent. The study highlights its advantages over synthetic repellents, including lower environmental impact, reduced health risks, and affordability for low-income communities. This aligns with global efforts to promote sustainable alternatives in public health interventions. Further, the study on the ethno geographical distribution of Mimosa species in the Philippines underscores their traditional medicinal uses. Many Mimosa species are used in folk medicine, and their potential applications in modern pharmacology are gaining recognition. This research supports the local utilization of Mimosa pudica in innovative products, including mosquito repellent formulations [19].

Statistical Treatment of Data

The data from mosquito-repellent bioassays, stability testing, and consumer acceptability surveys were analyzed using appropriate statistical methods to ensure valid and reliable conclusions.

1. **Analysis of Variance (ANOVA).** One-Way ANOVA was used to compare the mosquito-repellent efficacy across three formulations (5%, 10%, 15% Mimosa pudica extract). This method tested the hypothesis that different concentrations affected repellency, helping minimize Type I errors that multiple t-tests could introduce. Post-hoc Tukey's HSD Test identified specific differences in repellency between formulations.
2. **Repeated Measures ANOVA.** Used to assess changes in viscosity, appearance, and scent retention over time for stability testing under different conditions (room temperature, refrigeration, and high humidity). This method accounts for repeated measurements from the same sample.
3. **Chi-Square Test.** Applied to consumer acceptability data to analyze categorical preferences (appearance, texture, fragrance) between the formulations. This test ensured valid conclusions on consumer preferences.

To facilitate a comprehensive analysis of the collected data, both the frequency and percentage were systematically calculated using the following formula:

$P = F/N \times 100$

Where

P is the percentage

F is the frequency; andN is the total number of respondents

The total number of responses from the respondents for each statement served as the basis for calculating the weighted mean of each statement. The results were then interpreted using the following scale:

RESULT	WEIGHT	MEAN
Strongly agree	4	3.50- 4.00
Agree	3	2.50- 3.49
Disagree	2	1.50- 2.49
Strongly Disagree	1	1.00- 149

3. METHODOLOGY

This Chapter Contains the Study's Methodology.

Table 1. Materials and Usage

Material	Usage	Image
Mimosa Pudica (Extract)	Acts as the primary bioactive ingredient with potential mosquito-repellent properties. It may contain phytochemicals that deter mosquitoes while also contributing to the gel's overall functional properties.	
Carrageenan Powder	Functions as a gelling agent to provide the desired consistency and stability to the formulation. It helps in maintaining the structural integrity of the air freshener gel.	
Cucumber Melon Essential Oil	Used as a fragrance component to enhance the sensory appeal of the gel. While it contributes to the overall scent, it may also have minor insect-repellent properties.	

Sodium Benzoate	Serves as a preservative to prevent microbial growth and prolong the shelf life of the gel. This is crucial to maintain product safety over time.	
Xanthan Gum	Acts as a thickening and stabilizing agent, improving the texture and viscosity of the gel. It ensures even dispersion of active ingredients.	
Propylene Glycol	Works as a humectant and solvent, helping to dissolve active ingredients and maintain moisture in the formulation, preventing drying or cracking.	
Distilled Water	Serves as the solvent base for the gel, allowing the even distribution of all components while maintaining consistency.	
NaCl	May be used to adjust the ionic strength and viscosity of the gel, enhancing its stability and texture.	

The formulation of the ingredients was based on the parallel analysis the different acquired combinations. Table 1 the process in accordance with the research focus and the flow of the paradigm to affect the standard result in the experimentation.

Table 2. Formulation

Ingredients	% of weight		
Formula	I	II	III
Mimosa Pudica Extract (ml)	5.0	10.0	15.0
Carrageenan	2.5	2.5	2.5
Xanthan gum	1.0	1.0	1.0
Sodium benzoate	0.5	0.5	0.5
Propylene glycol	5.0	5.0	5.0
NaCl	0.5	0.5	0.5
Distilled water	82.5	77.5	72.5
Fragrance (ml)	3.0	3.0	3.0

Setups Comparison

1. Setup A (5% Mimosa pudica Extract): Lower concentration to observe if minimal extract still provides mosquito repellency.
2. Setup B (10% Mimosa pudica extract): Standard concentration expected to balance effectiveness and stability.
3. Setup C (15% Mimosa pudica extract): Higher concentration to determine if increased extract improves repellency without compromising gel stability.

Procedure of Experimentation

1. Mimosa Pudica Collection

Identify and collect fresh Mimosa pudica (sensitive plant) leaves and stems from a clean, uncontaminated area. Wash them thoroughly with distilled water to remove dirt and impurities. Air-dry the plant material in the shade for 3–5 days to preserve its bioactive compounds.1.2 Extraction of Mimosa Pudica. Grind the dried plant material into a fine powder using a blender. Extract the bioactive compounds using ethanol (95%) or distilled water through either the maceration or Soxhlet extraction method. Filter the extract using Whatman filter paper, then evaporate the solvent using a rotary evaporator. Store the final extract in an amber bottle at 4°C until further use.

2. Formulation of the Air Freshener Gel

2.1 Preparation of Gel Base

Dissolve carrageenan powder (2.5%) in distilled water with constant stirring. Heat the solution at 60–70°C for complete dissolution.

2.2 Addition of Active Ingredients

Add Xanthan gum (1.0%) gradually while stirring to achieve a stable gel consistency. Incorporate the Mimosa pudica extract in the pre-determined concentrations (5%, 10%, 15%) for Setups A, B, and C. Mix propylene glycol (5.0%) to improve the solubility of ingredients. Add cucumber melon essential oil (3.0%) for fragrance enhancement. Introduce sodium benzoate (0.5%) as a preservative to prevent microbial contamination. Adjust the viscosity by adding NaCl (0.5%) if necessary.

2.3 Homogenization and Storage

Stir continuously for 15–20 minutes until uniform. Pour the mixture into sterilized Containers and allow it to set at room temperature. Store samples at ambient conditions for evaluation.

3. Evaluation and Analysis of the Air Freshener Gel

3.1 Physical Characterization

Appearance. Observe color, clarity, and homogeneity of the gel.
Texture & Viscosity. Assess the gel's consistency using a viscometer.
PH Measurement. Use a pH meter to ensure the formulation is skin-safe (pH 5.5–7.0).

3.2 Mosquito-Repellent Activity

Conduct a bioassay in a controlled environment using Aedes aegypti mosquitoes. Apply the gel to test surfaces and introduce 20 mosquitoes per chamber. Observe and record repellency (%) over 30, 60, and 120 minutes.

3.3 Stability Testing

Store samples under different conditions (room temperature, refrigeration, and high humidity) for 4 weeks. Evaluate changes in appearance, viscosity, and scent retention weekly.

4. RESULTS AND DISCUSSION

Results and Discussion

This Section of the Study Evaluated the Efficiency of the Developed Product.

Table 3. Phytochemical Analysis of Mimosa Pudica

Components	Test	Observation	Inference		
			Leaf	Stem	Root
Tannin	Ferric chloride test	Greenish black precipitate	+	+	+
Alkaloid	Mayer's and Wagner's Test	Reddish brown precipitate	+	+	+
Saponin	Emulsion test	Presence of emulsion	+	+	+
Steroid	Salkowkis test	Red colour at interface	-	-	-
Falvanoid	Ammonium chloride test	Yellow colour	+	+	+
Phenol	Ferric-chloride test	Greenish brown precipitate	+	+	+
Cardiac glycosides	Keller-Killiani test	Yellow brick red color	+	+	+

Phytochemical analysis of Mimosa pudica confirmed bioactive compounds in its leaf, stem, and root extracts. Tannins, alkaloids, saponins, flavonoids, and phenols were identified, supporting mosquito-repellent and insecticidal properties. Cardiac glycosides were also found, which may deter insects but could pose toxicity concerns.

Figure 2. Analysis of the Chemical Composition of Fragrances and Makahiya Extract

Formula II (2:1 ratio) repelled mosquitoes but had an overpowering scent. Formula III (1:2 ratio) prioritized fragrance, reducing repellent effectiveness. Formula I (1:1 ratio) balanced both, making it the best dual-purpose option. The fragrance diffusion test showed that scent intensity varied by room size and ventilation, being stronger in small, enclosed spaces and weaker in larger, ventilated areas.

Table 4. Mosquito Repellent Efficacy Test

Trial	Formula	Extract: Fragrance Ratio	Focus	Mosquito Behavior Observed	Observation Duration	Colour	Odour
I	II	2:1	Repellent Effectiveness	Significant avoidance of gel-treated area	1 hour	Dark brownish-green	Strong, grassy, sweet
II	III	1:2	Fragrance Acceptability	Reduced avoidance, decreased repellent effect	1 hour	Light brownish-green	Strong, sweet, fruity
III	I	1:1	Balance Between Effectiveness and Scent	Moderate avoidance, balanced repellent and fragrance	1 hour	Lighter brownish-green	Fresh, sweet, fruity

Formula II (2:1 ratio) had strong repellent effects but a strong scent. Formula III (1:2 ratio) focused on fragrance, reducing its repellent power. Formula I (1:1 ratio) balanced both, making it the best dual-purpose option.

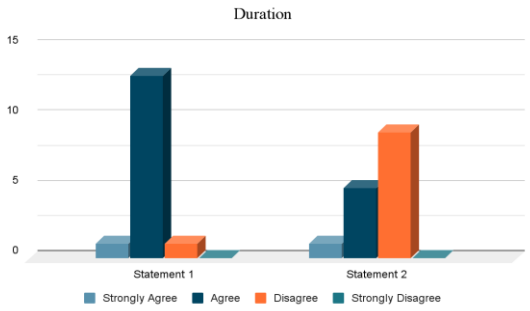

Figure 3. Distribution of Answers of the Respondents on the Questionnaire

Respondents reported that the fragrance of the air freshener did not last long and did not outlast other scented air fresheners. Thus, it showed no significant difference in fragrance compared to synthetic alternatives.

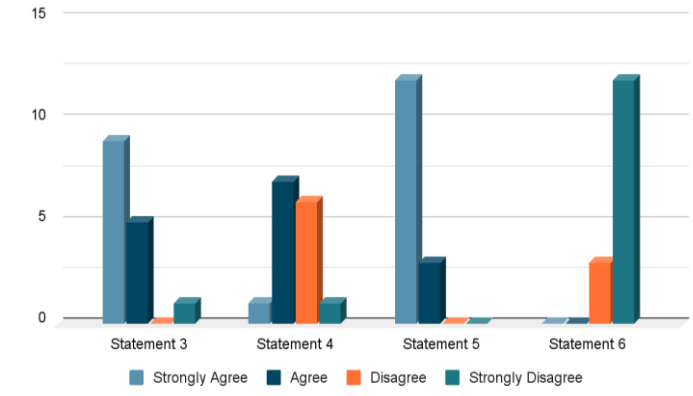

Figure 4. Scent Evaluation

Participants noted that the fragrance disperses immediately upon opening and lasts for 15-30 minutes, filling the surrounding area. To improve longevity, infusing cucumber melon and makahiya extracts is recommended.

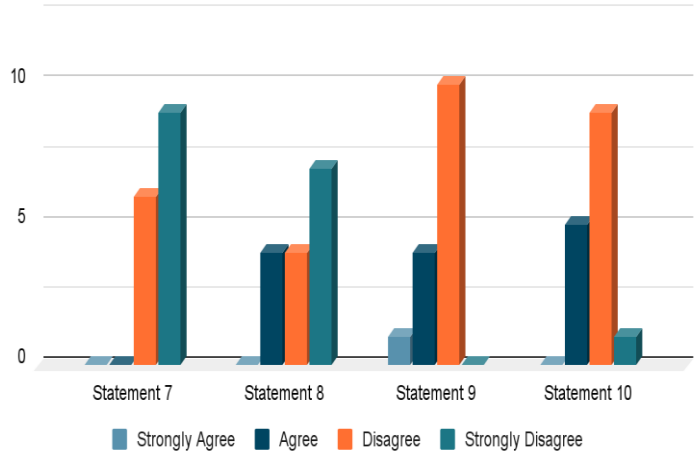

Figure 3. Consistency Evaluation

Respondents strongly disagreed with experiencing mosquito bites near the air freshener, indicating its effectiveness in repelling mosquitoes, particularly when placed nearby.

5. CONCLUSION

The study confirms that Mimosa pudica can be used as a natural mosquito repellent in an air freshener gel. The best formulation was Formula I (1:1 ratio), which provided a balance between repellent effectiveness and fragrance. The fragrance, however, had a relatively short duration, and the gel's efficacy was influenced by environmental factors like room size and ventilation. The product showed potential as an eco-friendly alternative to synthetic repellents, but improvements in fragrance longevity are needed.

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Author Contributions Statement

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Krizzia Jewel A. Marilag	✓	✓		✓		✓	✓	✓	✓	✓			✓	
Felix Elijah P. Alcontin		✓			✓			✓	✓	✓	✓	✓		
Kaina May D. Coquilla	✓	✓	✓			✓			✓			✓		✓
Elliza G. Madria	✓	✓		✓	✓	✓	✓		✓		✓	✓		✓
Jirah E. Winfield	✓		✓		✓	✓		✓	✓			✓	✓	✓

C	: **C**onceptualization	I	: **I**nvestigation	Vi	: **Vi**sualization
M	: **M**ethodology	R	: **R**esources	Su	: **Su**pervision
So	: **So**ftware	D	: **D**ata Curation	P	: **P**roject administration
Va	: **Va**lidation	O	: Writing - **O**riginal Draft	Fu	: **Fu**nding acquisition
Fo	: **Fo**rmal analysis	E	: Writing - Review & **E**diting		

Conflict of Interest Statement

The authors declare that there are no conflicts of interest related to this research. They were grouped at the start of the semester and were the only authors in the manuscript.

Informed Consent

All participants provided written informed consent before participating in the study. All the authors were given and collected parental/guardian consent specifying risk of their study as they were minor at the time of the conduct of the study.

Ethical Approval

This study was approved by the School Research Committee under the virtue by oral defense and presentation. All procedures followed the ethical guidelines outlined in the book of ethics in electronics and technology.

Data Availability

The datasets used and analyzed during this study are available from the corresponding author upon reasonable request.

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	**Elliza G. Madria** is a Grade 12 STEM student at Bayugan National Comprehensive High School. She has been a consistent honor student since elementary, ranking among the top achievers and securing a spot as a Top 5 student throughout her elementary and junior high school years. Beyond academics, Elliza is deeply involved in community service. She has served as the Vice President of Pabasa sa Mag-aaral (SAMAFIL) for four consecutive years, dedicating her time to helping junior high school students improve their reading skills. Her passion for education and leadership continues to inspire her peers, making a meaningful impact on her school community. Currently, she is actively engaged in scientific research and has co-authored a study titled "Mimosa Pudica (Makahiya) with Cucumber Melon Fragrance: A Natural Air Freshener and Mosquito Repellent". This research has been nominated as one of the Best Research Papers in her school, highlighting its potential contribution to society by providing natural alternatives for air freshening and mosquito control. She can be contacted at madriaelliza@gmail.com

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