



(RESEARCH ARTICLE)



Controlling Armyworm (*Spodoptera frugiperda*) Pest through the Use of Ginger, Garlic, and Chili Powder on Growing Mustasa Plant (June 2023)

Abadier Joanna M *, Alcantara Patricia Nicole N, Bandico, Flordeliza A, Waperina, Ana Maria S and Nograda, King Leonard

Laguna University, Sta. Cruz, Laguna, Philippines.

International Journal of Science and Research Archive, 2024, 11(02), 1352–1361

Publication history: Received on 25 February 2024; revised on 06 April 2024; accepted on 08 April 2024

Article DOI: <https://doi.org/10.30574/ijrsra.2024.11.2.0582>

Abstract

Growing in popularity as a sustainable and eco-friendly method of food production is organic agriculture. Organic pesticides have come to light as alternatives to traditional chemical-based pesticides as a result of this trend. Moreover, organic pesticides offer a sustainable method of crop protection that is consistent with organic farming's guiding principles. Because of this, there is rising interest in researching alternative pest management strategies, such as using organic insecticides made from natural ingredients.

Allium sativum (garlic), ginger (*Zingiber officinale*), and chile (*capsicum* spp.) are well known for their therapeutic and anti-fungal uses. Its potential as an efficient and environmentally friendly pest management method has recently come to light in research. This study was carried out with the intention of repelling and preventing infestations using organic materials in terms of leaves produce, crops yield, and plant survival. The researchers concluded that the level of effectiveness of the preferred concentration was 95% of ginger extract, 5% of garlic extract, and 5% of chili powder is effective with the weighted mean of 6 leaves produce and 30 bunches of crops yield and plant survival

Keywords: Organic; Pesticide; Effectiveness; Concentrations; Control; Prevent.

1. Introduction

In Asia, agriculture is one of the most important livelihoods of the people. Farmers in Asia cultivate different types of crops including green mustard which can be found in Southeast Asia. In the Philippines, green mustard is referred to as Mustasa: a green leafy vegetable that is among the healthiest available in the nation. Leaves are frequently used in soups and stews and are eaten as green leafy vegetables, either raw or pickled in brine. Due to these qualities and applications, mustard green has become one of the most popular green vegetables in the nation. Its lovely top greens have higher levels of vitamin A, carotene, vitamin K, and flavonoid antioxidants than other fruits and vegetables. Mustard greens are a vegetable that is packed with nutrients and easily cultivated. These mustard greens contain different pests that depend on the location. These pests not only damage the crops but also the farmers that suffer the loss of crop yields. Leading farmers to use pesticides including organic pesticides typically comes from natural resources that can be utilized to manage pests.

Ginger, garlic, and chili powder have numerous compounds that can be used to repel pests on the crop. It will be utilized as material to make an organic pesticide to prevent infestations. Chili powder is used by the researcher because it includes capsaicin, which is known to harm membranes and impair metabolism while acting as an effective insect repellent. The chemical that gives chili powder its spicy flavor, capsaicin, offends insects, because chili powder has the potential to irritate or burn some plants. Garlic's well-known sulfur compounds responsible for pungent odor that kill

* Corresponding author: Abadier Joanna M

or repel many of the most unpleasant garden pests, while it may also drive away certain helpful insects. An effective natural pesticide is garlic. A plant actively repels insects when garlic extract is taken by it, as a result of natural changes that occur in the leaf. The researchers want to keep pests out of plants; it is a good idea to use ginger. The chili powder and garlic may be included in the mixture.

Organic pesticides typically come from natural resources that can be utilized to manage pests. This comprises chemicals made from plants, minerals, and microbes. Pesticides made from organic plants that rely on a plant's inherent defenses against insects may not only be effective and affordable for safeguarding crops, but also safer and more beneficial to the environment. Pesticides made from organic plants that rely on a plant's inherent defenses against insects may not only be effective and affordable for safeguarding crops, but also safer and more beneficial to the environment. This insecticide is listed on the label as being effective against a wide range of insect pests, including fall armyworms, which prey on vegetables.

1.1. Objectives of the study

This study aims to;

- To assess the effectiveness of organic pesticides and the growth and yield of mustasa plants in a controlled production environment
- To evaluate the efficiency of ginger, garlic, and chili powder as an organic pesticide to control pests and prevent infestations of the mustasa crops.
- To manipulate the effectiveness of ginger, garlic, and chili powder organic pesticide in the crops after the application.

2. Materials and methods

2.1. Design

This study will provide an experimental type of research wherein the researchers will use to test the effectiveness of ginger, garlic, and chili powder organic pesticides. A thorough strategy for gathering and analyzing data in order to pinpoint causal linkages is known as an experimental design. The design of experiments allows you to have a reasonable possibility of discovering effects and testing hypothesis that address your research objectives through careful planning. An experiment is a method for gathering data under controlled circumstances in order to discover and comprehend causal correlations between variables. Researchers have a wide range of options for designs. The final decision is based on the study question, available resources, objectives, and constraints. The term "design of experiments" (DOE) is used by researchers in several disciplines of study to describe experimental design. Both names mean the same thing. Overall this experimental study will systematically examined the effectiveness of Organic Pesticides (Frost, 2023). Urban (2022) stated that organic insecticides are compounds that naturally kill pests. They don't hurt either people or animals.

Organic pesticides are also kind to the environment. Pesticides are substances that are applied to kill weeds, bacteria, fungi, insects, and other pests. Therefore the Humans and animals are not harmed by organic insecticides. Additionally, they are safer than traditional pesticides. Since many organic pesticides (also known as botanical pesticides) are made from plants, they won't harm your skin or eyes. These are employed for organic pest management. These natural pesticides are safe for both human and animal health because they don't contain any hazardous chemicals.

2.2. Materials and Procedure

In the first part of the research, the actual making of the organic pesticide was carried out. The following materials in making the organic pesticides are (1) Measuring Cup; (2) Measuring spoon; (3) Tupperware; (4) Grater shredder; (5) Funnel; (6) Gallon; (7) Gloves; (8) Piece of fabric. The procedures on how the organic pesticide was made were (1) Shred the ginger and garlic separately; (2) Extract the ginger and garlic using the piece of fabric (seperately). (3) Dissolve a chili powder to water; (4) Strain the excess residue from it; (5) Get the gallon and put 16 cups of water; (6) After filling up the water, add the extracted ginger and garlic, also the dissolve chili powder. (7) Stir to mix all the materials.

2.3. Data Collection and Analysis

A mustard green seed was spread throughout the plant bed. In collecting the ginger the researchers bought it from the market, as well as the adding raw material which is the garlic and chili powder. Since the researcher needed four (4) different concentrations of pesticide, there was a difference in the teaspoons (tsp.) of ginger, garlic and chili powder that is used per concentration.

Table 1 The concentration of Ginger, Garlic and Chili Powder in Ratio

Concentration	Percentage of concentration	Ginger (tsp.)	Garlic (tsp.)	Chili Powder (tsp.)
A	90:5:5	144	10	10
B	74: 13:13	98	6	6
C	85: 8:7	90	7	8
D	80: 11:9	120	11	9

As shown in Table 1, concentration A has one hundred forty-four teaspoons (144 tsp.) of ginger, ten teaspoons (10 tsp.) of garlic, and ten teaspoons (10 tsp.) of chili powder, for a ratio of 90:5:5, or 90% of ginger, 5% of garlic and, 5% of chili powder. Concentration B has ninety-eight teaspoons (98 tsp.) of ginger, six teaspoons (6 tsp.) of garlic and six teaspoons (6 tsp.) of chili powder that has 74: 13:13 ratios (74% in ginger, 13% in garlic, and 13% in chili powder). Concentration C has ninety teaspoons (90 tsp.) of ginger, seven teaspoons (7 tsp.) of garlic and eight teaspoons (8 tsp.) of chili powder. Concentration D has one hundred twenty teaspoons (120 tsp.) of ginger, eleven teaspoons (11 tsp.) of Garlic, and nine teaspoons (9 tsp.) of chili powder.

2.4. Effectivity of Organic Pesticides

Table 2 Number of data points need to determine the effectiveness of organic pesticides in terms of Leaves Produce

Number of leaves in one bunch	Effectivity
6 to 7	Effective
4 to 5	Moderate Effective
1 to 3	Not effective

In the research of Alautuan (2020), dose of water hyacinth liquid bio-organic fertilizer with bio-activator *Thricoderma* sp. 16 ml/L, and treatment E, which includes a dose of water hyacinth liquid bio-organic fertilizer with *Thricoderma* sp. 32 ml/L bio-activator, have the highest average number of green mustard leaves at 10.8 leaves.

Table 3 Number of data points need to determine the effectiveness of organic pesticides in terms of Crop Yield

Number of crop yield and plant survival	Effectivity
21 to 30	Effective
11 to 20	Moderate effective
1 to 10	Not effective

According to Albert (2023), transplants should be started inside four to six weeks before they are planted outside. Although mustard may thrive in a variety of soil types, it prefers wet, humus-rich soil. Mustard can withstand some shade. The best-tasting mustard has leaves that are between 4 and 5 inches (10–13 cm) long. Mulch helps keep the soil cool and wet to prevent bolting Plant 6 to 10 mustard plants per person living in the home to produce a crop of mustard greens.

Albert (2023) stated that transplants should be started inside four to six weeks before they are planted outside. Although mustard may thrive in a variety of soil types, it prefers wet, humus-rich soil. Mustard can withstand some shade. The best-tasting mustard has leaves that are between 4 and 5 inches (10–13 cm) long. Mulch helps keep the soil cool and wet to prevent bolting Plant 6 to 10 mustard plants per person living in the home to produce a crop of mustard greens

Table 4 The number of data points need to determine the effectiveness of organic pesticides in terms of Plant Survival

Number of crop yield and plant survival	Effectivity
21 to 30	Effective
11 to 20	Moderate effective
1 to 10	Not effective

3. Results and discussion

3.1. Level of Effectiveness of Concentration A, B, C, and D Organic Pesticide

Table 5 Level of Effectiveness of Different Concentrations Organic Pesticide.

	Concentration A	Concentration B	Concentration C	Concentration D
Leaves Produce	142 with weighted mean of 5	186 with weighted mean of 6	82 with weighted mean of 3	77 with weighted mean of 3
Interpretation	Moderately Effective	Effective	Moderately Effective	Moderately Effective
Crops Yields	30	30	16	14
Interpretation	Effective	Effective	Moderately Effective	Moderately Effective
Plant Survival	30	30	16	14
Interpretation	Effective	Effective	Moderately Effective	Moderately Effective

3.2. Level of Effectiveness of Concentration A Organic Pesticide

The concentration A has one hundred forty-four teaspoons (144 tsp.) of ginger, ten teaspoon (10 tsp.) of garlic, and ten teaspoons (10 tsp.) of chili powder, for a ratio of 90:5:5, or 90% of ginger, 5% of garlic and, 5% of chili powder. Concentration A Organic Pesticide in terms of leaves produce, crops yield, and plant survival. As seen in the table 1 in terms of leaves produce, it has a weighted mean of 5 that indicates as moderately effective, while on crops yield and plant survival have the total of 30 that remarks as effective. This explains that concentration A is moderately effective although the green mustard remains to its original number seedlings but the leaves produce is less than the expected number of developments. dose of water hyacinth liquid bio-organic fertilizer with bio-activator *Thricoderma* sp. 16 ml/L, and treatment E, which includes a dose of water hyacinth liquid bio-organic fertilizer with *Thricoderma* sp. 32 ml/L bio-activator, have the highest average number of green mustard leaves at 10.8 leaves. (Alautuan, 2020). Transplants should be started inside four to six weeks before they are planted outside. Although mustard may thrive in a variety of soil types, it prefers wet, humus-rich soil. Mustard can withstand some shade. The best-tasting mustard has leaves that are between 4 and 5 inches (10–13 cm) long. Mulch helps keep the soil cool and wet to prevent bolting Plant 6 to 10 mustard plants per person living in the home to produce a crop of mustard greens (Albert, 2023)

3.3. Level of Effectiveness of Concentration B Organic Pesticide

The concentration B has ninety-eight teaspoons (98 tsp.) of ginger, six teaspoons (6 tsp.) of garlic and six teaspoons (6 tsp.) of chili powder that has 74:13:13 ratios (74% in ginger, 13% in garlic, and 13% in chili powder). Concentration B Organic Pesticide in terms of leaf production, crop output, and plant survival. As shown in the table 1, it has a weighted mean of 6 which suggests effectiveness, whereas crop production and plant survival have a total of 30 which indicates effectiveness. This explains why concentration B has been effective in terms of the number of leaves produced, crop output, and plant survival in the plantation area. According to Alautuan (2020) Dose of water hyacinth liquid bio-organic fertilizer with bio-activator *Thricoderma* sp. 16 ml/L, and treatment E, which includes a dose of water hyacinth liquid bio-organic fertilizer with *Thricoderma* sp. 32 ml/L bio-activator, have the highest average number of green mustard leaves at 10.8 leaves. Transplants should be started inside four to six weeks before they are planted outside. Although mustard may thrive in a variety of soil types, it prefers wet, humus-rich soil. Mustard can withstand some shade. The best-tasting mustard has leaves that are between 4 and 5 inches (10–13 cm) long. Mulch helps keep the soil cool and

wet to prevent bolting Plant 6 to 10 mustard plants per person living in the home to produce a crop of mustard greens (Albert, 2023)

3.4. Level of Effectiveness of Concentration C Organic Pesticide

The concentration C has ninety teaspoons (90 tsp.) of ginger, seven teaspoons (7 tsp.) of garlic and eight teaspoons (8 tsp.) of chili powder that has 85:8:7 ratios (85% in ginger, 7% in garlic, and 8 in chili powder). Table 3 shows the effectiveness of Concentration C Organic Pesticide in terms of leaf production, crop output, and plant survival. As seen in the table 1, it has a weighted mean of 3 that suggests moderately effective, while crops production and plant survival have a total of 16 that shows moderately effective. This explains why concentration C is only partially effective, and why the number of leaves produced, crop output, and plant survival are less protected against plantation pests. Dose of water hyacinth liquid bio-organic fertilizer with bio-activator *Thricoderma* sp. 16 ml/L, and treatment E, which includes a dose of water hyacinth liquid bio-organic fertilizer with *Thricoderma* sp. 32 ml/L bio-activator, have the highest average number of green mustard leaves at 10.8 leaves (Alautuan, 2020). Transplants should be started inside four to six weeks before they are planted outside. Although mustard may thrive in a variety of soil types, it prefers wet, humus-rich soil. Mustard can withstand some shade. The best-tasting mustard has leaves that are between 4 and 5 inches (10–13 cm) long. Mulch helps keep the soil cool and wet to prevent bolting Plant 6 to 10 mustard plants per person living in the home to produce a crop of mustard greens (Albert, 2023).

3.5. Level of Effectiveness of Concentration D Organic Pesticide

The concentration D has eighty teaspoons (80 tsp.) of ginger, eleven teaspoons (11 tsp.) of garlic and nine teaspoons (9 tsp.) of chili powder that has 80:11:9 ratios (80% in ginger, 11% in garlic, and 9% in chili powder). The effectiveness of Concentration D Organic Pesticide in terms of leaf production, crop yield, and plant survival is shown in Table 1. As seen in the table, it has a weighted mean of 3 indicating moderate effectiveness, whereas crop output and plant survival have a total of 14 indicating moderate effectiveness. This explains why concentration C is only partially successful, and why plantation pests are less protected in terms of the amount of leaves produced, crop productivity, and plant survival (Maitimu and Aloatuan 2020). Dose of water hyacinth liquid bio-organic fertilizer with bio-activator *Thricoderma* sp. 16 ml/L, and treatment E, which includes a dose of water hyacinth liquid bio-organic fertilizer with *Thricoderma* sp. 32 ml/L bio-activator, have the highest average number of green mustard leaves at 10.8 leaves (Alautuan, 2020).

Table 6 Significant Difference in the Different Concentrations of Ginger, Garlic, and Chili Powder Organic Pesticides

Variable	SS	df	MS	F	P-value	F crit	Analysis
Leaves Produce	270.692	3	90.231	85.863	2.49752E-29	2.683	Significant
Crops Yield	7.567	3	2.522	19.592	2.40946E-10	2.683	Significant
Plant Survival	7.567	3	2.522	19.592	2.40946E-10	2.683	Significant

Table 2 corresponds to the significant difference in the level of effectiveness of the Different Concentrations of Ginger, Garlic, and Chili Powder Organic Pesticides in terms of leaves produce, crops yield, and plant survival. The number of independent bits of information is represented by the degrees of freedom which is 3. The ($F=85.863$, $p=2.49752E-29$) of the leaves produce indicates that the computed p-value is less than the significance alpha of 0.05. The ($F=19.592$, $p=2.40946E-10$) of the crops yield, and plant survival indicates that the computed p-value is less than the significance alpha of 0.05. From the given result, it can be implied that there is significant difference in the different concentrations of Ginger, Garlic, and Chili Powder Organic Pesticides, therefore null hypothesis is rejected. The overall results indicates that variety of concentrations of Ginger, Garlic, and Chili Powder Organic Pesticides have different effect towards the mustard green plants to control the pests in the plantation area. In the research of Noble et al. (2022) an average of 2.94 ants were captured for 20 minutes and 4.82 ants were captured for 30 minutes at a 10% concentration of ginger extract. 20% concentration of ginger extract, on average, 0.47 for 20 minutes and 1.18 for 30 minutes. Pardinan et al. (2020) stated that, the average for the control groups for 20 minutes of water was 1.76; for 30 minutes of water, 2.35; and for 20 minutes of magic chalk, 17.76; and for 30 minutes of magic chalk, 23.82. $F = 57.642$, $p = .000$ from a one-way analysis of variance revealed a significant difference in the number of ants caught between the experimental and control groups. In the res the 20% ginger extract and magic chalk groups had significantly different numbers of ants caught, according to Tukey's test. The quantity of ants captured in the ginger extract and negative control groups varied significantly from each other.

4. Conclusion

Based on the data gathered, the following conclusions were drawn: Findings showed that there is a significant difference in between the different concentrations of Ginger, Garlic, and Chili Powder Organic Pesticides in terms of leaves produce, crops yield, and plant survival; it means that null hypothesis is rejected. (1) The researchers concluded that using ginger, chili powder and garlic is effective as pesticides for mustasa plant. (2) The researchers concluded that the concentration B is the correct concentration that can repel the Armyworms. (3) The researchers concluded that the product can make a difference in terms of crop yields, plant survival and leaves produce. (4)

Recommendation

The researchers concluded that 60 pesos is a fair price for a ginger, garlic and chili powder as organic pesticides. In light of the above findings and conclusion, the following recommendations are respectfully endorsed: (1) Future researchers should consider expanding the sample size and including students from lower year levels to obtain a more comprehensive understanding of anxiety levels towards Mathematics, (2) Future researchers may develop a suitable rubric to analytically measure the effectiveness of the action plan, (3) Future researchers can build upon the findings of this study and develop their own action plan or intervention program tailored to addressing math anxiety, and (4) Interventions can focus on providing parents and family members with resources and support to promote a healthier and more relaxed approach to academic performance. Additionally, strategies can be developed to assist teachers and schools in managing student workload more effectively, ensuring that tests and assignments are spaced out to prevent students from feeling overwhelmed. Programs aimed at enhancing student communication and empathy can also be adopted, creating a supportive environment where individuals feel heard and valued for their perspectives.

Compliance with ethical standards

Acknowledgments

The researchers would like to emphasize the importance of the help, cooperation, and advice of different people in the betterment and completion of this study.

- To **Prof. Rose Nannette J. San Juan**, the research coordinator, for guiding researchers and providing them with this opportunity to conduct this study.
- To **Engr. King Leonard Nograda**, their research adviser, for imparting knowledge to the researchers' minds, providing ideas, and offering advice in developing the study, which made the researchers more curious in seeking answers to the questions that arose during the completion of this study. Her meaningful comments and suggestions have improved and made this research possible.
- To our panelists, **Mr. Jhonie Castro, Mr. John John Zotomayor, Ms. Jovelle Reyes and Prof Leah E. Perez** for giving advice, guidance, and putting in efforts to help the researchers improve this research. Their advice was significantly valuable throughout the research and writing of this thesis.
- To **Ms. Michelle Velasco**, statistician, for her dedication to computing and analyzing the gathered facts and data, and for her insightful contributions to the study.
- To **researchers' loving parents** for their financial support, moral support, and guidance in every decision the researchers make in life.

Disclosure of conflict of interest

The authors Joanna M. Abadier, Patricia Nicole N. Alcantara, Flordeliza A. Bandico, Ana Maria S. Waperina, And King Leonard Nograda show no conflict of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

References

- [1] Aminu, M.A, Hafiz, M.S, Shehu, S.A, Azeezat, Namadina, M.M4, Haruna, H., Mukhtar M.M, , Tasi'u, S, Yunusa A.Y, Biliyaminu, A Umar A.B., & Maitama, F.Y (2020). Influence of *Allium Sativum* (Garlic), *Zingiber officinale* (Ginger) and *Syzygium aromaticum* (Clove) Extract against Larvae of *Aedes* mosquitoes (Culicidae: Diptera). <https://www.ajol.info/index.php/dujopas/article/view/220513>

- [2] Asadollahi, A., Khoobdel, M., Zahraei-Ramazani, A., Azarmi, S., & Mosawi, S. H. (2019). Effectiveness of plant-based repellents against different Anopheles species: a systematic review. *Malaria Journal*, 18(1). <https://doi.org/10.1186/s12936-019-3064-8>
- [3] Biñas, N. F., Cuba, E. M., Gargarita, C. A., Minsu, A. J., Malaco, A. (2021). Organic Mosquito Patch: The Use of Lemongrass, Garlic and Marigold. <https://ejournal.upi.edu/index.php/AJSE/article/download/33665/14435>
- [4] Chan, C. S., Ho, L., & Sit, N. W. (2022). Larvicidal Activity and Phytochemical Profiling of Sweet Basil (*Ocimum basilicum* L.) Leaf Extract against Asian Tiger Mosquito (*Aedes albopictus*). *Horticulturae*, 8(5), 443. <https://doi.org/10.3390/horticulturae8050443>
- [5] Haegele, K., & Schneider, N., (2021) "Natural Remedies and Crafts for Home, Health, and Beauty" https://www.google.com.ph/books/edition/Kitchen_Witch/o9NAEAAAQBAJ?hl=en&gbpv=0
- [6] Hakeem, K.R., & Aftab T. (2021) "Medicinal and Aromatic Plants" https://www.google.com.ph/books/edition/Medicinal_and_Aromatic_Plants/LRomEAAAQBAJ?hl=en&gbpv=0
- [7] Husna, I., Setyaningrum, E., Handayani, T. T., Kurnia, Y., Palupi, E. R., Umam, R., & Andriana, B. B. (2020). Utilization of Basil Leaf Extract as Anti-Mosquito Repellent: A Case Study of Total Mosquito Mortality (*Aedes aegypti* 3rd Instar). *Journal of Physics*, 1467(1), 012014. <https://doi.org/10.1088/1742-6596/1467/1/012014>
- [8] Khanikor, B., Adhikari, K. P., & Rabha, B. (2021). "Citrus Essential Oils: A Suite of Insecticidal Compounds." <https://doi.org/10.5772/intechopen.95887>
- [9] Kumari, M., Srivastava, A., Sah, S. B., & Subhashini, N. (2022). Biological Control of Agricultural Insect Pests. *IntechOpen EBooks*. <https://doi.org/10.5772/intechopen.104464>
- [10] Lee M. Y. (2018). Essential Oils as Repellents against Arthropods. *BioMed research international*, 2018, 6860271. <https://doi.org/10.1155/2018/6860271>
- [11] Mitra, S., Rodriguez, S. D., Vulcan, J., Cordova, J., Chung, H., Moore, E., Kandel, Y. and Hansen, I. A. (2019). Efficacy of Active Ingredients From the EPA 25(B) List in Reducing Attraction of *Aedes aegypti* (Diptera: Culicidae) to Humans. <https://academic.oup.com/jme/article/57/2/477/5580737>
- [12] Mohamed, S. a. M. (2019). The Potential Repellency of Aqueous Extracts of Basil (*Ocimum basilicum* L.) leaves and Neem (*Azadirachta indica* A. Juss.) Seeds on *Anopheles arabiensis* (Diptera: Culicidae) sFemales. <http://repo.uofg.edu.sd/handle/123456789/5514>
- [13] Nour, A. H., IdriS, A. A., Ishag, O., & Nour, A. (2022). Chemical Composition and Repellent Activity of Methyl Cinnamate-Rich Basil (*Ocimum basilicum*) Essential Oil. *Journal of the Turkish Chemical Society, Section A: Chemistry*, 1277-1284. <https://doi.org/10.18596/jotcsa.1108807>
- [14] Nuhu, Abdulmumin (2014). "Bioactive Micronutrients in Coffee: Recent Analytical Approaches for Characterization and Quantification". <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4045301/>
- [15] Perez, J. L., Aguila, C. F., Mendoza, C. K., Pagcaliwagan, K. A., & Villena, K. S. (2019). "The Potential Use of *Coffea arabica* Grounds as *Aedes Aegypti* Mosquito Larvicide". <https://ojs.aaresearchindex.com/index.php/AAJMRA/article/view/2873>
- [16] Saadawi S., Eltalbi R., Erkhayes W., Abid S., Alennabi, K. A. (2021) "Effect Of *Thymus Vulgaris*, *Mentha Piperita* And *Pelargonium Citrosum* Leaf, *Syzygium Aromaticum* Buds And Citrus Limonoids Peels Extracts As Mosquito Larvicidal And Pupicidal Agent" https://www.researchgate.net/profile/Sakina-Saadawi-2/publication/354844932_Effect_Of_Thymus_Vulgaris_Mentha_Piperita_And_Pelargonium_Citrosum_Leaf_Syzygium_Aromaticum_Buds_And_Citrus_Limonoids_Peels_Extracts_As_Mosquito_Larvicidal_And_Pupicidal_Agent/links/614f6f0a522ef665fb5ecb8a/Effect-Of-Thymus-Vulgaris-Mentha-Piperita-And-Pelargonium-Citrosum-Leaf-Syzygium-Aromaticum-Buds-And-Citrus-Limonoids-Peels-Extracts-As-Mosquito-Larvicidal-And-Pupicidal-Agent.pdf
- [17] Sajid, S. (2022). Considering Alternative Mosquito Repelling Strategies. <https://pjph.org/index.php/pjph/article/view/1076>
- [18] Satho, Tomomitsu (2015). "Coffee and its waste repel gravid *Aedes albopictus* females and inhibit the development of their embryos". <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4436121/>
- [19] Smith, D., Battle, K. E., Hay, S. I., Barker, C. A., Scott, T. W., & McKenzie, F. E. (2012). Ross, Macdonald, and a Theory for the Dynamics and Control of Mosquito-Transmitted Pathogens. *PLOS Pathogens*, 8(4), e1002588. <https://doi.org/10.1371/journal.ppat.1002588>

- [20] Valeriano Jillian (2018). "Pesticidal Activity of Spent Coffee Grounds Extract on Rice Black Bugs (*Scotinophara coarctata*)". <https://ojs.aaresearchindex.com/index.php/AAJMRA/article/view/4047>
- [21] Vallar, M., Roa, N. A., Villanueva, K., & Flores, M. (2018). The larvicidal effect of *Ocimum basilicum* (basil) extract on *Aedes* mosquito larvae. <https://cdu.herdin.ph/index.php/component/herdin/?view=research&cid=72160>
- [22] Wiwanitkit, Viroj (2018). "Coffee waste, vector control, and dengue". <https://link.springer.com/article/10.1007/s11356-018-3360-9>
- [23] Yee,M.(2019).Investigation of Chemical Composition, Antimicrobial and Antioxidant Activities of *Allium Wallichii* Kunth (Garlic) Bulb.https://asrjetsjournal.org/index.php/American_Scientific_Journal/article/view/4750
- [24] Aditama, W., Zulfikar, and Sitepu, F.Y. (2018). "The effectiveness of arabica coffee (*Coffea arabica* L) grounds on mortality and growth of *Aedes aegypti* Larva". <https://www.dipterajournal.com/pdf/2019/vol6issue1/PartA/6-1-4-104.pdf>
- [25] Baldon, R. F., Baylon, F. N., Biases, M. A., Espalmado, S. M., Garais, A., Hesita, B. T., Sano, E. M., & Valiente, R. (2020). Sweet Basil (*Ocimum basilicum*) and Mint-Basil (*Mentha × piperita* f. *citrata*) leaves' Larvicidal Pellet for Mosquitoes [Research Paper]. <https://www.globe.gov/documents/10157/83fb07c0-e4ee-4a5c-a7a4-6e28efe52694#:~:text=The%20said%20review%20also%20found,the%20known%20carcinogen%2C%20methyl%20eugenol>
- [26] Beltran, B., Calusa, A., Castro, A. F., Jose, C. J., Mella, C., & Suarez, A. J. (2022). Basil AND Lemongrass AS FLY Repellents A Comparative Analysis FOR FLY Repellency. Studocu. <https://www.studocu.com/ph/document/our-lady-of-fatima-university/biology/basil-and-lemongrass-as-fly-repellents-a-comparative-analysis-for-fly-repellency-stem-12-1plus-jose/24411976>
- [27] Delos, A. V. R. (2019). "Lemon peels and Yerba Buena as Mosquito spraying repellent." https://www.academia.edu/40128624/Title_Lemon_peels_and_Yerba_Buena_as_Mosquito_spraying_repellent
- [28] Ghosh, S. & Malik, S. (2019). Synthesising natural ink from indian berries. Indian Journal of Applied Research: Volume - 9 [https://www.worldwidejournals.com/indian-journal-of-applied-research-\(IJAR\)/fileview/synthesising-natural-ink-from-indianberries_October_2019_1571897665_3013879.pdf](https://www.worldwidejournals.com/indian-journal-of-applied-research-(IJAR)/fileview/synthesising-natural-ink-from-indianberries_October_2019_1571897665_3013879.pdf)
- [29] Shukla, D., Wijayapala, S., & Vankar, P.S. (2018). Effective mosquito repellent from plant based formulation. International Journal of Mosquito Research, 5, 19-24.<https://www.dipterajournal.com/pdf/2018/vol5issue1/PartA/4-6-17-974.pdf>
- [30] Virtudazo,M,D.,Manuel,C,J.,Dimaculangan,A,F., Curilan M,R., Uy,J,E.,Tibangen,T., Hernandez G,R.,Encina,M,M.,and Cano,E, A.(2022).Larvicidal activity of *Allium sativum* against *Aedes*, *Anopheles*, and *Culex* spp.: A systematic review. <https://www.dipterajournal.com/pdf/2022/vol9issue6/PartB/9-6-11-332.pdf>
- [31] Adam, E. I. Y. (2020). Bioassay of Leaf Extracts of Sweet Basil (*Ocimum basilicum* L.), Wild Thyme (*Coleus forskohlii* Briq), Kafure (*Eucalyptus camaldulensis* Dehnh.) and Lemongrass (*Cymbopogon flexuosus* Steud.) as *Anopheles* Mosquito Repellents. <http://repo.uofg.edu.sd/handle/123456789/3704>
- [32] Adams, A. (2022). "Natural Mosquito Repellents by Alexandra Adams." <https://www.coxwellvet.com/natural-mosquito-repellents-by-alexandra-adams-aca-3/>
- [33] Aïzoun,N.,Koura,K. and Adjatin,A. (2021). "Effect Of Aqueous Extract of Lemon (*Citrus Limon*) On *Anopheles Gambiae* Sensu Lato (*Diptera: Culicidae*) Larvae Tolerance In Malaria Vector Control In Dogbo District In South-Western Republic Of Benin, West Africa." <https://gsconlinepress.com/journals/index.php/gscbps/article/view/gscbps-2021-0292>
- [34] Aminian, A. R., Mohebbati, R., & Boskabady, M. H. (2022). The Effect of *Ocimum basilicum* L. and Its Main Ingredients on Respiratory Disorders: An Experimental, Preclinical, and Clinical Review. *Frontiers in Pharmacology*, 12. <https://doi.org/10.3389/fphar.2021.805391>
- [35] Archyde. (2021). Does garlic help against mosquitoes? Key facts at a glance. Archy de. <https://www.archyde.com/does-garlic-help-against-mosquitoes-key-facts-at-a-glancea>
- [36] Ayers, Jeff (2023). "CAN COFFEE GROUNDS PREVENT PESTS?". <https://www.deathwishcoffee.com/blogs/coffee-talk/burn-coffee-to-fight-pests>
- [37] Baluyos,M.(2022).7 Easy, Natural ways to get rid of mosquitos at home. <https://sugbo.ph/2022/get-rid-of-mosquitos-at-home/>

- [38] Begum, J.. (2020). Lemon Oil: Health Benefits and How to Use It. WebMD. https://www.webmd.com/diet/lemon-oil-health-benefits?fbclid=IwAR2S3H2cutpVaWRmfc-rLK9vZ_BaKBHT9JnsUaK6vpiB-Fsdpi7oYOp9ft4#:~:text=Lemon%20oil%20can%20put%20you,decrease%20in%20symptoms%20of%20stres&text=Lemon%20oil%20has%20antimicrobial%20properties
- [39] Brazier, Y. (2019). Health benefits of basil. <https://www.medicalnewstoday.com/articles/266425>
- [40] Bustamante, J. (2021). "Lemon and Mosquitoes: Does Lemon ACTUALLY Repel Mosquitoes?" <https://mosquitoreviews.com/mosquito-repellents/lemon/>
- [41] Chattopadhyay, A., & Bakshi, S. D., Betal, S., & Banerjee, P. K. (2020) "Molecular identification and control of Culex mosquito by Citrus limon in West Bengal, India" <https://www.dipterajournal.com/archives/2021/8/1/A/7-6-7>
- [42] Clark,J.(2019). 20 Simple Ways To Get Rid of Mosquitoes. <https://healthytalbot.org/topics/20-simple-ways-to-get-rid-of-mosquitoes/>
- [43] Dumay, Michelle (2019). "The Effectiveness of Citronella Extract (Cymbopogon winterianus Jowit ex Bor) and Garlic Extract (Allium sativum) as Mosquito (Culicidae) Repellent". <https://www.ejournals.ph/article.php?id=14053>
- [44] Dykes, A. (2022). "Lemon Juice as a Mosquito Repellent" <https://www.hunker.com/13406229/lemon-juice-as-a-mosquito-repellent>
- [45] Elliot, Katie (2022). "'Go-to' Mosquito repellents: 5 expert tricks to naturally prevent bites". <https://www.express.co.uk/life-style/life/1646285/mosquito-repellent-adults-kids-lemon-juice-evg>
- [46] Emily, (2022) "How To Use Lime Juice To Keep Mosquitoes Away" <https://simplyhealthyvegan.com/how-to-use-lime-juice-to-keep-mosquitoes-away/>
- [47] Garden and Patio Home Guide (2021). "Coffee Grounds For Mosquitoes" <https://www.gardenandpatiohomeguide.com/coffee-grounds-for-mosquitoes/>
- [48] Gime,J,Y.(2021).How to get rid of pests: DIY home remedies for pest control.<https://www.philstar.com/lifestyle/modern-living/2021/07/23/2110799/how-get-rid-pests-diy-home-remedies-pest-control>
- [49] Hawiset, Thaneeya (2019). "Effect of one time coffee fragrance inhalation on working memory, mood, and salivary cortisol level in healthy young volunteers: a randomized placebo controlled trial". <https://www.sciencedirect.com/science/article/pii/S2213422019302628?via%3Dihub>
- [50] Hull, Lowena (2019). "Pesticides: the potential usage of coffee as an insect repellent". <https://distilledthoughts.home.blog/2019/06/08/pesticides-the-potential-usage-of-coffee-as-an-insect-repellent/>
- [51] Kate, (2018) "Repel Mosquitoes | Tips on How to Avoid Mosquito Bites." <https://nomadsworld.com/avoid-mosquito-bites/#:~:text=Drink%20lemon%20juice,to%20way%20to%20repel%20mosquitoes.>
- [52] Koren G. Matsui D. Bailey B. (2003). "DEET-based insect repellents". <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC167123>
- [53] Laurence (2022). "Do Coffee Grounds Repel Mosquitoes? (Fast Facts)". <https://roastybrews.com/coffee-repel-mosquitoes/>
- [54] Lejeune Brian (2022). "DO COFFEE GROUNDS REALLY KEEP BUGS AND MOSQUITOES AWAY?". <https://parachutecoffee.com/blogs/coffee-general/do-coffee-grounds-keep-bugs-away>
- [55] Linda (2022). "Coffee's Effectiveness As A Mosquito Repellent". <https://www.thecommonscafe.com/coffees-effectiveness-as-a-mosquito-repellent/>
- [56] Lleit,K,A.(2022). Fight rising dengue cases! Natural insect repellents you can prepare at home.<https://www.philstar.com/lifestyle/health-and-family/2022/08/05/2197887/fight-rising-dengue-cases-natural-insect-repellents-you-can-prepare-home>
- [57] Madzharov, Adriana et al (2018). "The impact of coffee-like scent on expectations and performance". <https://www.sciencedirect.com/science/article/abs/pii/S0272494418302615>
- [58] Marengo, Katherine (2021). "Coffee grounds: Skin scrubs, dyes, cleaners, and more". <https://www.medicalnewstoday.com/articles/uses-for-coffee-grounds>

- [59] Martin, N. (2022). "Does Lemon Repel Mosquitoes? Let's Check Citrus VS Insects." <https://pestcontrolhacks.com/does-lemon-repel-mosquitoes/>
- [60] Martin,N (2022).Does Garlic Repel Mosquitoes? Review Of The "Smelly" Insecticide.<https://pestcontrolhacks.com/does-garlic-repel-mosquitoes/>
- [61] Matichub. (2021). "Kape (Coffea)" . Matic Hub. <https://maticph.wordpress.com/2021/06/02/kape-coffea/>
- [62] Mawis, A. V. L. (2019). Alternative ways to dengue-proof your home | Inquirer Business. INQUIRER.net. <https://business.inquirer.net/275999/alternative-ways-to-dengue-proof-your-home>
- [63] Mcintosh,J. (2022).19 Plants That Repel Mosquitoes.<https://www.thespruce.com/plants-that-repel-mosquitoes-4583885>
- [64] Michel, C. (2023). 12 Plants and Herbs That Naturally Repel Mosquitoes. Country Living. <https://www.countryliving.com/gardening/garden-ideas/g2479/plants-that-repel-mosquitoes/>
- [65] Milkstas, C. (2022). Health Benefits of Basil. WebMD. <https://www.webmd.com/diet/health-benefits-basil>
- [66] Nagrale, P.M., Kambale, R.K., & Patil, P.V. (2022). Natural ink synthesis from flowers of flame of forest (butea monosperma), common lantana (lantana camara), and berries of malabar spinach (basella alba). Ethiopian Journal of Environmental Studies & Management 15(4): 443 - 449, 2022. <https://ejesm.org/wpcontent/uploads/2022/08/ejesm.v15i4.3.pdf>
- [67] Olsen, N. (2019). Health benefits of basil. <https://www.medicalnewstoday.com/articles/266425>
- [68] Onasanya, S.S., Onasanya, O.O., Sobayo, T.O., & Tijani, R. O. (2021).Formulation and preparation of aerosol using garlic oil and its insecticidal effects on crawling and flying insects.<https://visnav.in/ijacbs/article/formulation-and-preparation-of-aerosol-using-garlic-oil-and-its-insecticidal-effects-on-crawling-and-flying-insects/>
- [69] Patterson,D,M.(2019).Garlic to water ratio for bug repellent. <https://homeguides.sfgate.com/garlic-water-ratio-bug-repellent-88909.html>
- [70] Prieto, Ria (2018). "Could just the smell of coffee be enough to give your brain power boost?" <https://lifestyle.inquirer.net/300645/p2fb-just-smell-coffee-enough-give-brain-power-boost/>
- [71] Primer (2018). "How To Use Your Coffee in Different Ways". <https://tinyurl.com/3j4r98n9>
- [72] Sheikh,Z.and Mate,P.(2020).A Review on: Herbal Mosquito Repellent. <https://web.s.ebscohost.com/abstract?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=09767126&AN=145656972&h=fKIXfio1Mp2RQHy7u23INK5TtY47BBnv6xYjt8KTINIj37D4Zxa8I%2b0BAI2Ykk4jyOMEXLap7mLtK7qPSn3iDw%3d%3d&crl=c&resultNs=AdminWebAuth&resultLocal=ErrCrINotAuth&crlhashurl=login.aspx%3fdirect%3dtrue%26profile%3dehost%26scope%3dsite%26authtype%3dcrawler%26jrnl%3d09767126%26AN%3d145656972>
- [73] Silva & Ricci-Junior (2020). "An approach to natural insect repellent formulations: From basic research to technological development". <https://www.sciencedirect.com/science/article/abs/pii/S0001706X19311970>
- [74] Wahyuni, A. D., Zahra, S. F., Putri, B. Q., Pramudya, M., Rohmah, E. A., & Mulyatno, K. C. (2022). A Preliminary Study on Ocimum basilicum Essential Oil as a Repellent against Aedes aegypti in Surabaya. JOURNAL OF PUBLIC HEALTH FOR TROPICAL AND COASTAL REGION, 5(2597-438). [https://file:///C:/Users/jonje/Downloads/13734-53278-1-PB%20\(1\).pdf](https://file:///C:/Users/jonje/Downloads/13734-53278-1-PB%20(1).pdf)
- [75] Wolfe, M. (2022). Does basil repel mosquitoes? We tested it to find out. HappySprout. <https://www.happysprout.com/gardening/basil-repel-mosquitoes/>
- [76] Yoo,C. (2022).12 Mosquito Repellent Plants. <https://www.gardendesign.com/plants/mosquito-repellent.html>
- [77] Zone. (2022). 5 DIY Solutions to Reduce Mosquitoes on Your Property | Zone Pest. Zone Home Solutions. <https://www.zonehomesolutions.com/5-diy-solutions-to-reduce-mosquitoes/>