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Efficacy of Oregano Leaves and Lemongrass Extract as Organic Household Insect Repellant

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ABSTRACT

This study sought to assess the effectiveness of oregano leaves and lemongrass extract as organic household insect repellant against flies. The objectives were to determine the resistance rate of flies influenced by oregano leaves and lemongrass extract and to evaluate the efficacy of these natural ingredients as organic insect repellant. The research utilized a Completely Randomized Design (CRD) with three treatment groups: Treatment 1 (500g of Dried Oregano Leaves Extracts + 500ml of Ethanol), Treatment 2 (500g of Dried Lemongrass Extracts + 500ml of Ethanol), and Treatment 3 (500g of Dried Oregano Leaves + 500g of Dried Lemongrass Extracts + 500ml of Ethanol). Using descriptive statistics and T-Test analysis to measure the resistance rate and efficacy of oregano leaves and lemongrass extracts. The results indicated that Treatment 1 and Treatment 3 were highly effective in repelling flies, with statistically significant differences compared to Treatment 2. Therefore, oregano leaves and lemongrass extract show potential as effective organic household insect repellants against flies. These findings contribute to the existing literature and offer a safer alternative to synthetic insecticides.

Keywords: *Oregano Leaves, Lemongrass Extract, Organic Household Insecticide, Efficacy, Flies, Experimental Research*

INTRODUCTION

The global health consequences of insects like flies and mosquitoes cannot be overstated. Biting insects like mosquitoes, black flies, deer flies, horse flies, and many others can damper the time spent outside. Moreover, many fly species lay their eggs in human waste and other dirt and then transfer disease-causing organisms to other sources, including our food, drinking water, and bodies. Flies are a primary vector for many infectious diseases. The current state of technology prevents people from solving every fly problem, and the methods used to eliminate flies are only partially effective. Nonetheless, established methods are frequently effective at reducing fly populations and minimizing the risk of insect-borne disease transmission.

Globally, essential oils (EOs) extracted from aromatic plants have seen a significant uptick in use as low-risk pesticides in recent years, thanks in large part to the growing interest of organic farmers and conscientious shoppers. EOs are abundant in volatile, low-molecular-weight terpenes and phenolics, and they are simply distilled from plant material using steam. Various insects can be deterred or killed by EOs, and their growth can be stunted. While registration has been the primary stumbling block to introducing

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new items to the market, the United States has shown greater success in approving the use of EOs than any other country (Regnault-Roger et al., 2012).

In the Philippines, the effectiveness of Oregano and Lemongrass as organic household insect repellant is a helpful solution for preventing insects for how many years, specifically house flies that are harming our body skin or might give us diseases that include typhoid fever, diarrhea, dysentery, cholera, trachoma, African sleeping sickness, and onchocerciasis (Aw, 2018). They use it differently, putting it in a clay container with burning charcoals to produce a cloud of smoke and using its strong aroma to repel insects. Using organic insecticide is way safer since its organic ingredients are organically farmed without using chemical fertilizers, herbicides, and pesticides.

Moreover, to being an effective organic household insect repellant, oregano and Lemongrass have been valued for their medicinal properties in traditional medicine practices. Oregano contains compounds like carvacrol and thymol (Sharififard et al., 2018), which have antimicrobial and antifungal properties, making it helpful in treating respiratory infections and digestive issues. Conversely, Lemongrass contains citral, a compound known for its insect-repellant properties and its potential to reduce inflammation and relieve pain. Its soothing aroma is also commonly used for aromatherapy and relaxation purposes. By harnessing the power of these natural ingredients, the Filipino method of using oregano and Lemongrass as insect repellants help protect against harmful insects and offer potential health benefits.

In the locality, no related literature or studies about Oregano and Lemongrass as insect repellants exist. No reference has been found. It only means that this topic is new to the field of research. However, the problem of insects causing harm in households is still an issue for many of us. There are many inorganic insecticides—commercial products that could be found in different markets in our local places that the researcher cannot mention. One of the reasons why the researcher has to come up to introduce an organic solution to these different problems that the world is facing, aside from the fact that the province of Davao del Sur is abundant of oregano, where most can be found around the locality and also, lemongrass is usually used to spies up foods which most of the households are planting it on their backyard; easy to find.

Literature Review

Lemongrass

Often referred to as Citronella oil, the effect of Lemongrass essential oil is believed to last approximately two and a half hours. It is significantly more for some mosquito species. Lemongrass has been promoted as one of the most significant plants for repelling the impact of and from mosquitos due to these established properties. Lemongrass is a well-known insect repellant. According to a 2021 study, almost 95% of mosquitos from a specific range of species were either killed or entirely repelled by the lemongrass oil's pungent odor (Yoo, 2021).

The global incidence of mosquito-borne diseases such as dengue, Zika, chikungunya, yellow fever, and malaria has significantly increased. As a preventive measure against mosquito bites, repellants are considered one of the most effective strategies. Consequently, a growing interest has been in exploring plants with repellant properties. This review about "An approach to natural insect repellant formulations: from basic research to technological development" (Agrawal et al., 2020) conducted a comprehensive analysis to identify plants with repellant activity by examining scientific literature, patents, and commercially available products. Active compounds such as limonene, 1,8-cineole, geraniol, eugenol, and citronellal were commonly present in plants' essential oils with repellant activity. Sprays and lotions were the most widely marketed among the various natural repellant formulations. Emulsion-based formulations were commonly used in patents, followed by lotions and sprays. Microparticles were identified as the preferred extended-release systems for natural repellants (Mapossa et al., 2021). Citronella essential oil emerged as the most frequently used ingredient in classic commercially available formulations and extended-release systems described in literature and patents (Wu et al., 2022). Moving forward, future

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research should explore the utilization of nanotechnology to develop extended-release systems containing essential oils with repellant activity, utilizing natural and biodegradable materials (Amar-Yuli et al., 2018). These studies can be related to the mentioned study on Lemongrass essential oil in terms of its effectiveness as an insect repellant, particularly against mosquitoes. The fact that Lemongrass oil is believed to have a lasting effect of approximately two and a half hours, with even greater efficacy against certain mosquito species, aligns with the focus of the researcher's study on the impact of this oil on mosquitoes. Additionally, the 2011 study mentioned above, which found that nearly 95% of mosquitoes from a specific range of species were either killed or entirely repelled by the pungent odor of lemongrass oil, provides supporting evidence for the repellant properties of Lemongrass.

By considering and referencing these relevant studies, the researcher can strengthen the credibility of his research and highlight the existing knowledge and evidence on the effectiveness of Lemongrass essential oil as an insect repellant, particularly against mosquitoes.

Lemongrass Components

Lemongrass essential oil contains the active chemicals myrcene, limonene, citral, geraniol, citronellol, geranyl acetate, neral, and nerol. While myrcene and limonene are aromatic chemicals, citral and geraniol have antibacterial and insecticidal properties, respectively (Aluyor & Oboh, 2014). This oil is effective against fungi, bacteria, and insects in general. Additionally, Lemongrass oil is a natural food preservative. According to recent research, using pure lemongrass essential oil as an alternative to synthetic fungicides or other cleanliness measures in storage and packing is a novel and useful strategy. The essential oil's usefulness as an alternative food preservative is dependent on the target pathogen.

Application of Lemongrass as Insect Repellant

The efficacy of Lemongrass essential oil is comparable to that of commercially available insecticides. According to Fradin (2019), the chemical compounds citronellol and geraniol are present in the substance under consideration, which is effective against a diverse range of biting insects. According to Baldacchino et al. (2013), the substance can be administered topically, incorporated into lotions, or dispersed onto fabrics and other materials, based on personal preferences.

In addition, lemongrass oil is derived via steam distillation from the fresh and dried leaves of the lemongrass plant. This lemon-scented oil ranges in hue from pure yellow to reddish yellow and has a water-like viscosity (Tovar et al., 2011). This essential oil is not only nice to smell, but also contains a number of active compounds (NIH, 2020). Many of us are familiar with the culinary and therapeutic applications of lemongrass oil. Lemongrass oil is an excellent option for repelling blood-sucking insects such as mosquitoes, fleas, lice, and ticks. In comparison to commercial products, it is less expensive and has no significant adverse effects (Anggraeni et al., 2018).

Moreover, when it comes to pest management, we begin by searching the market for a chemical-based insecticide that is not only expensive, but also environmentally damaging. When given the option, it is always preferable to utilize natural insect repellants. Lemongrass essential oil is as effective as any insecticide commercially available. Citronellol and geraniol are present, and it is efficient against a wide variety of biting insects. It can be applied directly to the skin, combined with lotions, or sprayed on garments and other surfaces, depending on individual tastes (QuickHome, 2021).

The cited studies provide insightful context for the researcher's investigation of Lemongrass as an insect repellant. The results indicate that Lemongrass essential oil is highly effective at repelling bite insects, including mosquitoes, fleas, lice, and ticks. Comparable to commercially available insecticides in terms of effectiveness, making it a cost-effective and environmentally friendly alternative. Citronellol and geraniol are present in Lemongrass oil, which contributes to its repellant properties. It can be applied directly to the skin, mixed with lotions, or sprayed on various surfaces, providing a variety of application methods based on the user's preferences. The studies support the benefits of using lemongrass oil as a natural insect repellant, emphasizing its efficacy and applicability in pest management technique.

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Pharmacological Activities of Lemongrass

Lemon grass extract has been used in hypolipidemic and hypoglycemic medications. It has been used in folk and Ayurvedic medicine to manage glucose, cholesterol, and fat levels in the blood serum, hence preventing obesity and hypertension. It is typically consumed as tea (Reau, 2011). Moreover, several studies have shown that Cymbopogon citratus has anti-amoebic, antibacterial, antidiarrheal, antifilarial, antifungal, and anti-inflammatory effects. Antimalarial, antimutagenicity, antimycobacterial, antioxidants, hypoglycemic, and neurobehavioral properties have also been investigated. These findings are very intriguing and suggest that this herb should be investigated further to validate these findings and show further potential therapeutic properties (Shah et al., 2011).

These studies on the pharmacological properties of Lemongrass have necessary implications for the researcher's investigation. The findings indicate that Lemongrass extract has traditionally been used to regulate glucose, cholesterol, and fat levels, thereby preventing obesity and hypertension. In addition, Lemongrass possesses additional pharmacological properties, including antibacterial, anti-inflammatory, antioxidant, and antimalarial properties. In addition to its role as an insect repellant, these findings highlight the therapeutic potential of Lemongrass.

By referencing these studies, the relevance and context of the researcher's study are expanded. It indicates that in traditional medicine, Lemongrass extract has been historically utilized for its hypolipidemic and hypoglycemic properties. In addition, the diverse pharmacological activities exhibited by Lemongrass indicate the need for additional research into its potential therapeutic benefits. These findings broaden the scope of the researcher's study and highlight the complexity of Lemongrass as a medicinal plant.

Oregano

By referencing these studies, the relevance and context of the researcher's study are expanded. It indicates that in traditional medicine, Lemongrass extract has been historically utilized for its hypolipidemic and hypoglycemic properties. In addition, the diverse pharmacological activities exhibited by Lemongrass indicate the need for additional research into its potential therapeutic benefits. These findings broaden the scope of the researcher's study and highlight the complexity of Lemongrass as a medicinal plant.

Oregano is indigenous to temperate western and southwestern Eurasia, as well as the Mediterranean. Oregano leaves are an herb plant (WebMD, 2020). Oregano is more than simply a plant; it also has several medicinal properties (Patel, 2022). According to Katzer's study (2007) Origanum vulgare (oregano leaves) is a flowering plant. It is also a member of the mint family. It can be used as a regular herb or as an alternate material for our purposes. Mosquitoes (culicidae) are actually recognized to be hazardous to humans. Mosquitoes are destructive to both our environment and our health. Because mosquitoes are harmful to humans, we must reduce their population (EPA, 2022).

This study will investigate the use of oregano leaves as a mosquito repellant. Oregano was chosen as the subject of this study because it contains components with the potential to repel mosquitoes. Specifically, thymol and carvacrol are known for their mosquito-repellant or repellant properties. This plant's oregano oil is renowned for its potent antiseptic and insect-repellant properties (Alizadeh et al., 2018). The previously cited studies on the properties and applications of oregano provide pertinent information for the researcher's investigation into using oregano leaves as a mosquito repellant. Oregano is a flowering plant native to temperate Eurasia and the Mediterranean, according to these studies. It is a member of the mint family and has medicinal properties. A study by Katzer (2007) identifies Oregano and its information validates oregano's suitability for the researcher's study by using its botanical history and characteristics.

Oregano Components

Oregano oil is a well-known antiseptic and insect repellant. It contains several active chemicals, including carvacrol, thymol, and -terpinene, which have been shown to be quite effective at repelling mosquitoes (Sharififard et al., 2018). Thymol and carvacrol are two components that have the capacity to

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avoid or repel mosquitoes (Sharififard et al., 2018). Insects, according to common belief, despise the herb's fragrant oils (LNPC, 2023). Oregano also contains thymol, a-terpinene, and carvacrol. These chemicals make it an efficient pesticide that scares insects. As a result, many pest-like insects avoid coming near oregano plants, but not all insects. Additionally, oregano is a culinary plant that is not only flavorful but also effective at repelling mosquitoes (Sharififard et al., 2018). Mosquitoes tend to avoid the plants due to their unusual odor. However, oregano leaf oil extract is also excellent for manufacturing all-natural repellant sprays (OldWorldGardenFarms, 2021).

The cited studies offer valuable insights and support for the researcher's investigation into the components of oregano and its potential as a mosquito repellant. Even though some insects may still be attracted to oregano plants, many pest-like insects tend to avoid them due to their fragrant oils and distinctive odor. This supports the researcher's goal of using oregano leaves as a mosquito repellant, as it confirms oregano's repellant properties and its potential efficacy in warding off mosquitoes. Moreover, the fact that oregano leaves oil extract can be used to produce all-natural repellant sprays strongly proves the relevance of these studies to the researcher's study, as it suggests various practical applications of oregano as a mosquito repellant.

Pharmacological Activities of Oregano

Oregano essential oils are extensively recognized for their antibacterial, antiviral, and antifungal activities. Nonetheless, current research has established that these chemicals are also highly effective antioxidant, anti-inflammatory, anti-diabetic, and cancer suppressor agents (Leyva-López et al., 2017). These oregano essential oil qualities may be of interest to the culinary, cosmetic, and pharmaceutical industries. Oregano has been shown to be beneficial in treating stomach aches, bacterial/fungal infections, inflammatory bowel disease, and other conditions (Rowles, 2023). As a result of its medicinal and native applications, oregano has a great economic value (Khan, 2020).

Application of Oregano Leaves and Lemongrass as Insect Repellant

In recent decades, a considerable number of herb-drying investigations have been done, and numerous herb-drying systems have been introduced. However, commercial dried herbs are still of poorer quality than fresh herbs. In the last 20 years, there has been a surge in interest in herb-drying research. Using the Web of Science with "herb" and the name of the drying method as topics and "drying" as a title, for example, a growing trend of studies in different drying methods may be detected. Drying techniques have been created with the goal of improving quality while also providing new opportunities to raise the drying process's efficiency (Busic et al., 2014).

For the past 20 years, many studies on drying processes have focused on improving the quality features of dried herbs. Despite these technical advancements, achieving high-quality dried herbs remains a challenge because herbs are highly sensitive to changing drying process conditions, particularly in terms of color and scent. Furthermore, the quality of dried herbs is highly dependent on the type of herb, harvesting season, postharvest techniques, plant age, and storage conditions. As a result, optimizing quality necessitates investigating each individual drying procedure for each variety of herb (Thamkaew et al., 2020). Furthermore, the reason why the researcher won't use fresh plants in extraction is that because they believe that it will only slow the process of extracting the essential oils coming from the plants based on the related study above. Despite these advances, producing high-quality dried herbs remains difficult due to herbs' sensitivity to changing drying process conditions.

In addition, the researcher used ethanol as solvent for extraction method of plants. Ethanol is also approved for use as a plant growth regulator (a ripener). Isopropanol is also used to kill fleas, ticks, and other domestic insects when combined with other pesticide-active components. Both ethanol and isopropanol are well-known chemicals with several human applications. One of the safest methods of extracting soluble plant components is solvent extraction. It produces comparable results to other regularly used processes and is one of the most affordable solutions available, making it popular in the essential oil

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and botanicals industries. It is simple to establish a rapid, safe, and low-cost workflow using ordinary laboratory equipment (Cole-Parmer, 2020).

There are several products that are already existing in the market and most households are using them as insect repellants or eliminators. But little did they know that these products can cause dangerous effects on their health when ingestion, inhaled, and in contact with skin, eyes, and clothing. Especially for the kids that could possibly be left and lifted by them when they are alone. It is better to secure our loved ones before they get hurt than making action after it happened. People can't reverse the past into the present, so think in advance before it causes damage.

Household Insect Repellant Sprayer is one of the products that the researcher meant here. People can't bring it anywhere inside the house when they saw some mosquitoes or flies around. Also, it is dangerous for the kids and even for the adults if they'd forgot that they've placed it somewhere. And that is how the idea of this product comes up, making and providing a solution without giving another problem to solve.

Consumers used a product that is handy, safe, and hundred percent effective. Therefore, the Oregano and Lemongrass household Insect Repellant is a useful solution to get the desired product against insects. The best thing about this product is that it is made from organic, and most of the consumers knows about these ingredients and where they can find them in the surroundings. And some related studies were developed to prove its effectiveness and that it can be used as a repellant for cockroaches (Rahayu et al., 2021) was published in October 2021. Another is the results suggested that the essential oils of lemongrass, clove, oregano, and thyme have significant antifungal action; nevertheless, consumers will tolerate only therapy with lemongrass oil (Bozik, 2016) was published in December 05, 2016.

The German cockroach (Blattella germanica) has long been a nuisance in cities and a vector for various infections that pose a concern to human health. It plays a function in human vertigo, asthma, and nausea reactions. Widespread resistance has developed due to the increased use of synthetic insecticides to control the German cockroach population. In Indonesia, it has demonstrated resistance to permethrin, propoxur (Rahayu et al., 2012), and many pyrethroid insecticides. Commercial pesticides used via contact or spray methods may have ceased to be effective in Indonesia at managing German cockroach populations (Rahayu et al., 2016).

On the other hand, essential oils derived from natural items offer hope for controlling German cockroach populations in Indonesia. Citronella essential oil is effective against males (Sahara & Rahayu, 2014), females, and nymphs (Jannatan et al., 2017) of the German cockroach. Another essential oil derived from crude papaya leaf extract is tested for its efficacy in cockroach pest management.

The presence of various secondary metabolites such as alkaloids, terpenoids, flavonoids, carotenoids, and tannins in Lemongrass plants, as reported by Avoseh et al. (2015), suggests its potential as a bioinsecticide. Several studies have been conducted to determine the efficacy of specific essential oils. Monoterpenes, which are derived from terpenoids isolated from lemongrass (Cymbopogon citratus), have been shown to interfere with neurotransmitter function in insects (Da Silva et al., 2015). Tannin chemicals are known to decrease the activity of enzymes involved in insect digestion.

Although lemongrass has been proven to contain chemicals capable of suppressing cockroach populations, there is still a shortage of information regarding the particular strategies for employing it. As a result, the mentioned study above focused on determining the most effective method of using lemongrass essential oil to manage the mortality German cockroach population. Additionally, it evaluated the usefulness and effectiveness of lemongrass essential oil as a bioinsecticide.

The study mentioned above pertains to German cockroaches' provision and rearing process. This research was carried out at the Research Laboratory of Animal Physiology, affiliated with the Department of Biology at Universitas Andalas, between August 2016 and February 2017. Field strains of German cockroaches were observed to have originated from two urban centers in Indonesia, namely Bandung (referred to as the KRS-BDG strain) and Jakarta (referred to as the HHB-JKT strain). The present study acquired a standardized control population of cockroaches by the World Health Organization (WHO)

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definition. The cockroaches were obtained from the Vector Control Research Unit, School of Biological Sciences, Universiti Sains Malaysia, and belonged to the VCRU-WHO strain. The cockroaches utilized in the study were cultivated by the prescribed methodology at the Research Laboratory of Animal Physiology housed within the Department of Biology at Universitas Andalas. The cockroaches had an unrestricted amount of cat food (specifically, the Pedigree brand) and water. The rearing environment was maintained at a temperature range of 24-28°C, a relative humidity range of 84-86%, and a photoperiod of 12 hours of light followed by 12 hours of darkness. Male German cockroaches were utilized in this investigation because their physiological state is relatively steady in the face of hormonal fluctuations, particularly when exposed to the bioinsecticide chemical.

Provision of lemongrass essentials oils: Lemongrass essential oil was purchased commercially from the Indonesian Research Center for Spices and Medicinal Plants in West Sumatra, Indonesia. The dosage employed in the contact toxicity test was 3.15 mg cm–2 of lethal residue (LR90), which killed approximately 90% of cockroaches within six hours on average. The repellency test employed a sub-lethal residual concentration of 10% of the LR90 dosage. In contrast, the fumigation toxicity test used a 100% concentration of lemongrass essential oil, stained on cotton, and placed in a 1 L plastic container to generate fume. The amount of lemongrass oil used in this investigation was selected based on the preliminary test results for lethal residues (LR). Table 1 contains the fatal residue values (LR50 and LR90) determined in an initial test of lemongrass essential oil against German cockroaches after 6 hours of observation with a contact toxicity test.

Contact toxicity test: Lemongrass essential oil was given to German cockroaches using the Tarsal Contact Test, as established (Nasir et al., 2017). 3.15 mg cm–2 lemongrasses essential oil residue was selected since the cockroaches will die gradually over a 24-hour period following exposure. Fumigation toxicity test: This test followed a previously described protocol (Herwina et al., 2017), in which German cockroach resistance was monitored every 24 hours. After six days of fumigation, unless the resistance of German cockroaches reaches 100%, the test should be discontinued due to the essential oil expiring after this time period. Three times the therapy was administered. Repellency test: The repellant test was conducted using a sub-lethal dose of lemongrass essential oil (residue 0.16 mg cm 2) in accordance with established protocol. Cockroach distribution was monitored every hour for the first six hours, and then once at 24 and 48 hours after exposure. Three times the therapy was administered.

In the Philippines, Lemongrass and Oregano were used to control pests in the rice field as a traditional solution for the problem of shortage of rice harvest (Cabarogias & Nicolas, 2015). Despite the widespread use of chemical pesticides in rice farming, traditional farmers in Camarines Sur continue to advocate for pest management using indigenous knowledge systems. The sustained use of these approaches in controlling rice pests can be due to their effectiveness, affordability, communicability, ecological soundness, and sustainability. Indigenous pest management practices were formerly and extensively used in the province.

These rituals were inherited from their forefathers and passed down orally from generation to generation. The availability of chemical pesticides did not compel them to abandon the practices passed down from their predecessors. They confirmed to the efficacy of these indigenous techniques despite the lack of scientific validation.

The survey's findings indicate that traditional rice farmers in Camarines Sur continue to value the use of indigenous knowledge for pest control, despite agriculture's modernization and commercialization. Table 2 summarizes the 24 indigenous pest control methods currently being used at various stages of rice production. Only four are employed seldom, including the removal of diseased plants, the employment of cats and ducks as biological control agents, and handpicking insect pests. According to respondents (Cabarogias & Nicolas, 2015), these methods are labor intensive, time-consuming, and impractical for farms with a hectare or greater in size. The frequency of usage is indicative of patronage.

In the locality, there's no such related literature and studies about Oregano and Lemongrass as insect repellants. No reference has been found. It only means that this topic is new to the field of research.

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Yet, the problem of insects that are causing harm in households is still an issue for many of us. The Department of Health dispatched a team from the National Epidemiology Center (NEC) to Digos City, Davao del Sur, last July 8, 2010, to validate the 253 dengue cases and ten deaths reported in the media. Additionally, Mayor Joseph Peñas of Digos City proclaimed a state of calamity, according to the news report. Barangay Tres de Mayo had the highest number of cases (23%). The team cooperated with the Department of Health's regional office (CHD - Davao Region) and Digos City's municipal government, including its City Health Office (CHO), which reported the cases (Govt. Philippines, 2010) and was published in July 15, 2010.

METHODS

Collection and Identification of the Plant Materials

Oregano leaves and lemongrass were collected from Brgy. Ruparan, where these plants were available. For the oregano leaves, the identified green color leaves were gathered. The freshly collected oregano leaves were washed separately with clean tap water to removed debris, and then air-dried for 7 days at room temperature until it became moisture-free. The plant materials were inspected daily until optimum dryness were achieved. A comprehensive assessment was conducted to identify the optimum dryness and moisture-free condition of the oregano leaves and lemongrass extract. The evaluation considered factors such as visual appearance and texture. The dryness level was determined by observing the leaves for any signs of moisture, such as softness or dampness while maintaining their characteristic texture and color.

Various physical indices were considered, including the age of the oregano and lemongrass leaves. Younger leaves were preferred as they tend to have a higher concentration of active compounds. The leaves were carefully selected based on visual appearance, ensuring they were vibrant and free from any signs of wilting or decay.

For the collection of lemongrasses, green color grass was used. Clean cutting instruments and chemical-free containers were used and washed. Collected lemongrass were washed separately with clean tap water to removed debris. And was subjected to air drying to reduce their moisture content for about 7 days. To reduced possible contamination, especially by fungi, gloves will wear during leaf and grass collection.

Air-Drying Step-by-Step

Pre-drying: Excess moisture was removed from the leaves using pre-drying methods before air drying. This can be done by spreading the leaves in a single layer on clean, absorbent materials such as paper towels or drying racks. They were left in a well-ventilated area at room temperature for a few hours to reduce moisture content.

Drying environment: The leaves were transferred to a suitable drying environment in a clean and well-ventilated area with good air circulation. It is crucial to ensure that the drying area is free from humidity, direct sunlight, and any sources of contamination.

Air drying: The leaves were evenly spread out in a single layer to promote airflow around each leaf. This prevents the accumulation of moisture and facilitates uniform drying. Care was taken to avoid overcrowding the leaves, which could hinder proper air circulation.

Mold prevention: To prevent mold formation during the drying process, monitoring the temperature and humidity of the drying environment is essential. The ideal temperature for air-drying oregano leaves and lemongrass is around 25-30°C (77-86°F), with humidity below 60%. If necessary, dehumidifiers or fans were used to maintain suitable drying conditions.

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Drying duration: The leaves were left to air dry for seven days, typically ranging from one week. The leaves moisture content and visual appearance were regularly monitored to determine when they reached the desired dryness level.

Preparation of Mixtures of Plant Extracts

Ethanolic extraction and preparation of various treatment concentrations were conducted at Brgy. Ruparan, Digos City, Davao del Sur.

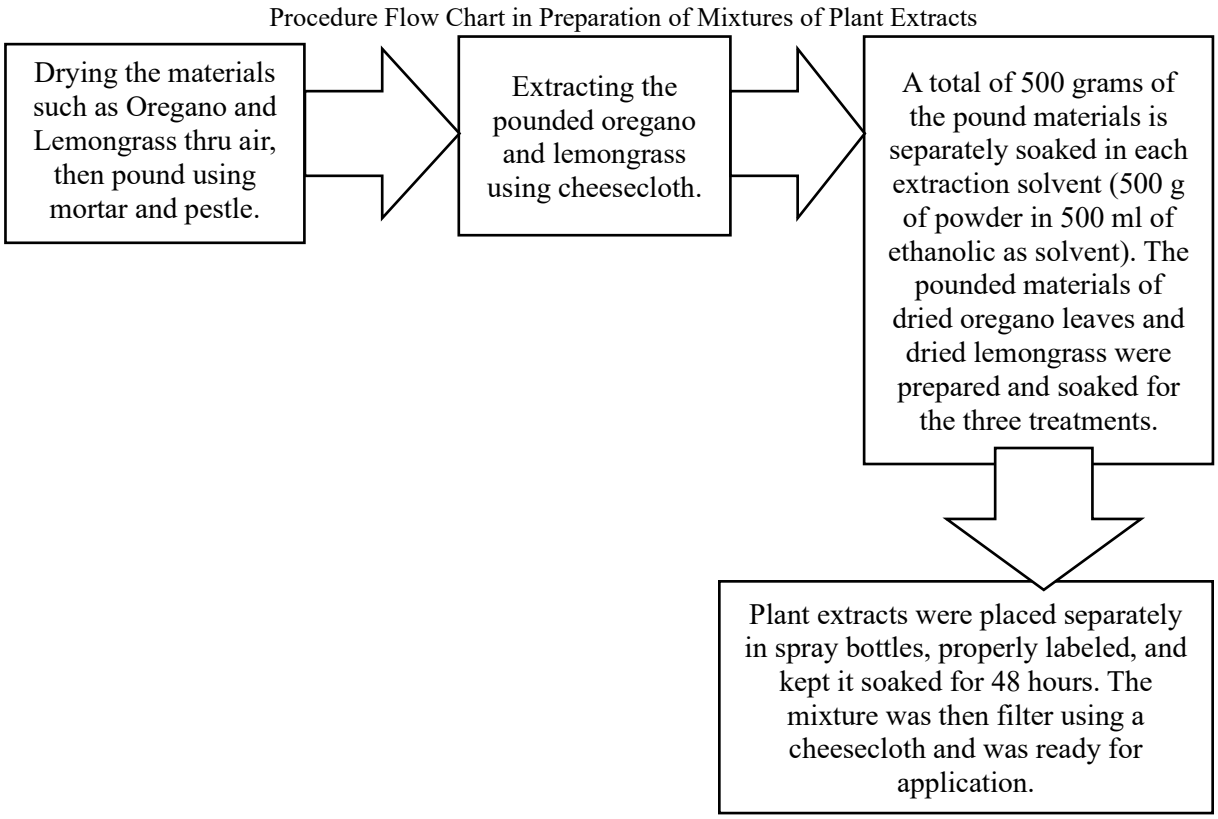

Figure 2. *Procedure flow Chart Showing the Preparation of Mixtures of Plant Extracts*

Step 1. The air-dried material was subject to manual grinding (using a mortar and electrical blender to manually grind the air-dried leaves of lemongrass and oregano).

Step 2. A pure concentration was obtained via ethanolic extraction by soaking the material in 75% ethanol for 48 hours, followed by filtration using a clean cloth.

Step 3. A total of 500 grams of the pound materials is separately soaked in each extraction solvent (500 g of powder in 500 ml of ethanolic as solvent). The pounded materials of dried oregano leaves and dried lemongrass were prepared and soaked for the three treatments:
Treatment 1 (500 grams dried oregano leaves + 500 ml ethanol);
Treatment 2 (500 grams dried lemongrass leaves + 500 ml ethanol);
Treatment 3 (500 grams dried oregano leaves + 500 grams dried lemongrass leaves + 500 ml ethanol).

Step 4. The plant extracts were placed separately in spray bottles, properly labeled, and kept it soaked for 48 hours. The mixture was then filter using a clean cloth and was ready for application

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Flies Observation Area

In a closed field of piggery area at Brgy. Ruparan, Sitio San Miguel, Purok 5- Lavander, Digos City, where there are countless flies lingering around the perimeter of a pig farm. The age and maturity of the flies weren't considered as long as it is available. There were nine (9) paper plates that have food leftovers placed on the tables to attract the subject to it, and observed for 2-5 minutes to wrote a partial report of observation without the application of treatments.

After that, the researcher had applied the three (3) treatments on the three different paper plates with food leftovers, respectively, and observed for 30 minutes to approximately 1 hour. Then write down all the observations afterward.

Experimental Design

The experiment was laid out in a Completely Randomized Design (CRD). There were three treatment (T) groups, replicated three times. Treatment 1 was treated with 500 grams of Dried Oregano Leaves Extracts, Treatment 2 with 500 grams of Dried Lemongrass Extracts, and Treatment 3 was treated with 500 grams of Dried Oregano Leaves + 500 grams of Dried Lemongrass Extracts. The efficacy of oregano leaves and lemongrass extract against household flies assessed by measuring the resistance across different treatments. Efficacy was determined by evaluating repellency in different treatment concentrations.

Experimental Layout

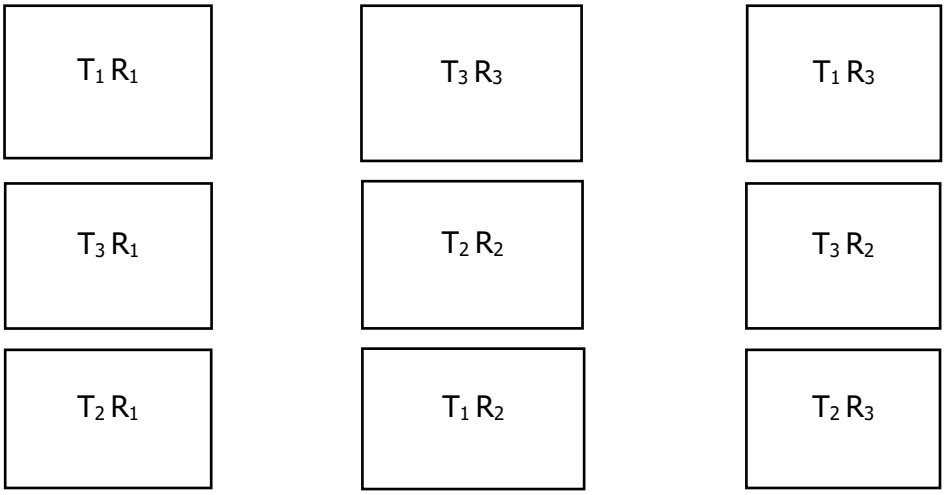

Figure 3. *Experimental Layout of Three Treatment*

Research Design

In this study, a quantitative experimental research design was applied. According to Creswell (2013), this design is a methodical and scientific method to study in which the researchers modify one or more variables, and control and measure any change in other variables. Hence, it measures the causal link between the independent variable which is the type of treatment and the dependent variables which is the efficacy and the resistance rate. It is this light that this design has utilized since the researchers want to discover if the oregano leaves and lemongrass extracts possess insect repellant action against flies.

Research Locale

The collection of Oregano leaves and Lemongrass were at Brgy. Ruparan, Digos City, since it can be seen available in the area. Most of the residents in the area were also affected by the disturbance of flies. Ethanolic extraction and preparation of various treatment concentrations were conducted at Brgy. Ruparan,

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Digos City, Davao del Sur. This study was conducted at Brgy. Ruparan, Sitio San Miguel, Purok 5-Lavander, Digos City, with a population as determined by the 2010 Census was 2, 873 in the area (PSA, 2010).

Research Instrument

The researcher utilized an Evaluation Rating Scale to acquired information for this study. The Evaluation Rating Scale focused on the efficacy of the Oregano leaves and Lemongrass extract on flies. A Resistance Rate Index was utilized to evaluate the effectiveness of oregano leaves and lemongrass essence.

The scoring guides of the responses were categorized into five ratings:

Rating	Description	Number of Flies that Landed on the Paper Plate after applying treatment/s.
4	Extremely Effective	0 flies per 30 minutes
3	Very Effective	5-10 flies per 30 minutes
2	Effective	10-20 flies per 30 minutes
1	Slightly Effective	20-30 flies per 30 minutes
0	Not Effective	30-40 flies per 30 minutes

Data Gathered

This study was concentrated on the efficacy assessment and monitoring of oregano leaves and lemongrass extract on flies. The Resistance caused by all treatments on the experimental flies were documented and analyzed. Specific data such as the number of flies that landed under different treatments and the efficacy of each treatment concentration was also documented.

Nine (9) paper plates with food leftovers (fermented anchovies and lechon baboy) on them were placed on the table provided, suitably designated based on their concentrations and replications. Ten (10) sprays of each concentration were immediately added to the three replicated paper plates for 1 hour of exposure. Each paper plate was thoroughly evaluated for any flies landed at 30 minutes up to 1 hour with 30 minutes time intervals. It was rated according to the resistance criteria. The resistance criterion was as follows: if there's no single fly being landed on the paper plate with treatment, it has recorded as effective and tallied in resistance statistics.

Data Gathering

The following test was undergone by the researcher in gathering the data:

1. Obtained a letter from the Department Chairperson signed by the adviser stating that the researcher was allowed to conduct the study.
2. The best treatment among the 3 different tests in the development was used.
3. Prepared extracts were applied to the collected samples and gathered the relevant information regarding to the efficacy or assessment of the extracts on the samples.
4. Results were presented to the panel of critics.

Statistical Tools

This study applied T-Test to determine the substantial change in the resistance rate and effectiveness of flies when exposed to various oregano and lemongrass leaves extracts. In addition, it was employed in this investigation for independent samples to verify the important difference in the effectiveness of oregano leaves and lemongrass extracts when applied to the collected samples. Mean flies' resistance and associated outcomes of the study were reported using descriptive statistics.

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Ethical Consideration

In conducting research, it was important to consider research ethics in gathering the data. Ethics is the branch of philosophy that was concerned with resistance, which means to behave morally and how people can achieve that goal. It was important to asked permission from the owner of the farm to decide whether they have participated or not.

It was also important to put the gathered data confidentially to respect the involved personnel's privacy. The informed consent document explains the purpose of the study and that there was no risked in participating in the study. Moreover, the participation of the owner was voluntary, therefore they have all the rights to refuse or/and leave the study at any time.

RESULTS AND DISCUSSION

Resistance Rate of Household Flies and Efficacy of Oregano Leaves and Lemongrass Extract as Organic Household Insect Repellant

The study aimed to evaluate the effectiveness of oregano leaves and lemongrass extract as organic household insect repellants. The study's specific objectives were to determine the resistance rate of flies affected by oregano leaves and lemongrass extract, as well as their effectiveness as an organic household insect repellant.

Table 1 below presents the results of efficacy of oregano leaves and lemongrass extract as household insect repellant and resistance rate of flies among 3 treatments with 9 replications. Based on the descriptive analysis and one-sample t-test conducted on the data obtained from the experiment, the mean and standard deviation of each treatment group are provided in the first section of the table. The mean efficacy of oregano leaves and lemongrass extract as household insect repellant and resistance rate of flies for Treatment 1 (T1) with 500 grams of Dried Oregano Leaves Extracts + 500 ml ethanol (M=3.80; SD=0.45) and Treatment 3 (T3) with 500 grams of Dried Oregano Leaves + 500 grams of Lemongrass Extracts + 500 ml ethanol (M=3.20; SD=0.84) are very effective.

Table 1. Efficacy and Resistance Rate of Flies as Influenced by Oregano Leaves and Lemongrass Extract.

Indicator	Mean	Sd	Descriptive level
T1R1	3.8000	0.44721	Very Effective
T1R2	2.2000	1.09545	Effective
T1R3	3.0000	1.00000	Very Effective
T2R1	1.2000	0.83666	Slightly Effective
T2R2	1.8000	1.78885	Slightly Effective
T2R3	2.8000	0.44721	Effective
T3R1	3.2000	0.83666	Very Effective
T3R2	3.0000	0.70711	Very Effective
T3R3	2.8000	0.44721	Effective

Also, it was significantly higher than the test value of 3.002 with a p-value of 0.016 and 0.009, the t-test results show and reject the null hypotheses that "there is no significant difference in the resistance and efficacy of oregano leaves and lemongrass extract against flies among the 3 treatments". However, the mean resistance rate of flies for Treatment 3 (T3) did not show significant difference from the test value.

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Table 2. One-Sample Test: Efficacy and Resistance Rate of Flies as Influenced by Oregano Leaves and Lemongrass Extract.

Indicator	t	Df	Sig. (2-tailed)	Description
T1R1	3.990	4	0.016	There's a significance
T1R2	-1.637	4	0.177	No significance
T1R3	-0.004	4	0.997	No significance
T2R1	-4.816	4	0.009	There's a significance
T2R2	-1.503	4	0.207	No significance
T2R3	-1.010	4	0.370	No significance
T3R1	0.529	4	0.625	No significance
T3R2	-0.006	4	0.995	No significance
T3R3	-1.010	4	0.370	No significance

*Test Value = 3.002
*p-value = 0.05

Therefore, based on the results, oregano leaves and lemongrass extract have the potential to be an effective organic household insect repellant against household flies. Moreover, the results for each indicator will be revealed in the following:

Treatment 1. Table 1 above presents the results of efficacy of oregano leaves as household insect repellant and resistance rate of flies among treatment 1 with 3 replications. Based on the descriptive analysis, T1R1 has a mean value of 3.8 and a low standard deviation of 0.45, indicating that it is very effective as an insect repellant. T1R2 has a mean value of 2.2 and a high standard deviation of 1.09545, indicating that it is effective but less consistent compared to T1R1. T1R3 has a mean value of 3.0 and a standard deviation of 1.0, making it also very effective but less consistent compared to T1R1.

The findings from the Sritabutra and Soonwera (2013) study support the results obtained from evaluating oregano leaves. Their study evaluated the repellant activity of essential oils from various herbs against Aedes aegypti and Culex quinquefasciatus mosquitoes. Citronella, lemongrass, and basil essential oils demonstrated the highest repellant activity against both mosquito species. This aligns with the effectiveness of oregano leaves as an insect repellant in Treatment 1, particularly with citronellal and geraniol compounds in oregano.

These findings suggest that oregano leaves may be a viable alternative to synthetic mosquito repellants, particularly their essential oils. The consistent effectiveness observed in Treatment 1 suggests that oregano leaves may be an effective insect repellant for the home. The correlation with the study by Sritabutra and Soonwera supports the notion that oregano, along with other herbs like citronella and lemongrass, contains mosquito-repelling compounds. These results demonstrate the promising potential of oregano as a natural and effective mosquito repellant.

Treatment 2. Table 1 above presents the results of efficacy of oregano leaves as household insect repellant and resistance rate of flies among treatment 2 with 3 replications. Based on the descriptive analysis, T2R1 has a mean value of 1.2 and a standard deviation of 0.84, indicating that it is slightly effective as an insect repellant. T2R2 has a mean value of 1.8 and a high standard deviation of 1.79, making it slightly effective but less consistent compared to T2R1. T2R3 has a mean value of 2.8 and a low standard deviation of 0.44721, indicating that it is effective.

The results of Khater et al. (2019) study validate the outcomes derived from assessing oregano leaves. The research conducted by the authors centered on investigating the insecticidal properties of oregano oil against a range of insect pests, including the common housefly. The study exhibited that oregano oil exhibited significant efficacy in managing insect pests, particularly in the case of house flies, which displayed a heightened vulnerability to the oil. The research additionally discovered that oregano oil engendered resistance in domestic flies over time, exhibiting a significant repellant impact on flies.

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The findings suggest that oregano leaves, specifically their oil, exhibit insecticidal and repellant characteristics that may prove efficacious in combatting flies. The modest efficacy noted in Treatment 2 is consistent with the outcomes of Khater et al.'s (2019) investigation, which revealed that oregano oil exhibited the management of house flies. The insecticidal and repellant activities observed in oregano are likely attributed to bioactive compounds, namely carvacrol and thymol. The results underscore the viability of oregano as a feasible and effective remedy for naturally managing fly populations. Additional investigation is required to optimize the concentration and duration of exposure to augment the efficacy and uniformity of oregano leaves as a fly repellant.

Treatment 3. Table 1 above presents the results of efficacy of oregano leaves as household insect repellant and resistance rate of flies among 1 treatment with 3 replications. Based on the descriptive analysis, T3R1 has a mean value of 3.2 and a standard deviation of 0.84, indicating that it is very effective as an insect repellant. T3R2 has a mean value of 3.0 and a low standard deviation of 0.71, making it very effective and consistent compared to T2R2. T3R3 has a mean value of 2.8 and a low standard deviation of 0.45, indicating that it is effective.

The research carried out by Akkari et al. (2015) provides evidence for the efficacy of oregano essential oil as a pesticide in controlling houseflies and other fly species. According to their study, the efficacy of oregano essential oil against houseflies was found to be significantly high, with a resistance rate of 97.7% at a concentration of 10 ppm. The efficacy of the essential oil was also observed against various species of flies, such as blowflies and fruit flies.

The results suggest that oregano leaves, specifically their essential oil, possess potent insecticidal characteristics that can proficiently repel flies. The outcomes derived from Treatment 3, which demonstrated the high or moderate efficacy of oregano leaves in repelling flies, are consistent with the research conducted by Akkari et al. (2015). The findings suggest that oregano leaves are highly reliable as an insect repellant, as evidenced by the consistency observed in T3R2 and T3R3.

The findings highlight the possibility of utilizing oregano as an eco-friendly and non-synthetic approach to managing fly populations. The efficacy of oregano leaves in repelling flies is demonstrated by the high effectiveness and low resistance rate observed in T3R1, as well as the supportive evidence from the study conducted by Akkari et al. (2015). Additional investigation may be necessary to optimize the concentration and application techniques to augment oregano leaves' overall efficacy and uniformity as a domestic insect deterrent against flies.

CONCLUSION

The research aimed to test the efficacy of oregano leaves and lemongrass extract as organic household insect repellants. The flies' resistance rate and the products' efficacy were measured through a test with three treatments and nine replications. The results showed that Treatment 1 and Treatment 2 were significantly effective in repelling insects and had a higher resistance rate than Treatment 3. Therefore, the study suggests that oregano leaves and lemongrass extract have the potential to be an effective organic household insect repellant against flies.

With contemplations of the results and findings elaborated above, the following conclusions were drawn.

1. The resistance rate of flies as influenced by oregano leaves and lemongrass extract is very effective.
2. The efficacy of oregano leaves and lemongrass extract as an organic household insect repellant is very effective.

In consonance with the findings and conclusion presented above, the following were recommended:

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Recommendations

1. To determine the resistance rate of flies as influenced by oregano leaves and lemongrass extract, the researcher should conduct the test with a more significant number of samples.

2. In terms of determining the efficacy of oregano leaves and lemongrass extract as an organic household insect repellant, the researcher should have a more significant number of samples to test its efficacy.

3. The product may try to test with other subjects, such as mosquitoes and cockroaches.

4. Further research may be conducted to explore other products that could come up from oregano leaves and lemongrass extracts liquid spray insect-repellant, such as mosquito coil.

5. The researcher should explore the possibility of obtaining a utility model for the oregano leaves, and lemongrass extract liquid spray insect-repellant. A utility model provides exclusive rights to use and exploit an invention for a limited period, allowing for commercialization and protection against unauthorized use.

6. Collaboration with the DOST. Seeking support from DOST (Department of Science and Technology) can provide access to funding, expertise, and resources for further research, development, and potential commercialization of the oregano leaves and lemongrass extract liquid spray insect-repellant.

7. It is advisable to pursue a patent for the developed product. A patent grants exclusive rights to the inventor, preventing others from using, manufacturing, or selling the invention without permission. Seeking patent protection safeguards intellectual property and allows for potential commercialization and market exclusivity.

8. Additional laboratory tests are recommended to gather more comprehensive data on the efficacy and safety of the oregano leaves and lemongrass extract liquid spray insect-repellant. Further testing should encompass different concentrations, exposure durations, and experimental conditions to establish a more robust scientific basis.

References

Agrawal, N., Azeem, M., Banerjee, S., Benelli, G., Cal, K., Chattopadhyay, P., Chellappandian, M., Choochote, W., Cleton, N., Cosimi, S., Cu, J., Dickens, J. C., El-Sheikh, T. M. Y., Souza, C. F., Fouad, H. A., Fonseca-Santos, B., Gillij, Y. G., Gokulakrishnan, J., Govindarajan, M., & Campos, E. (2020). An approach to natural insect repellant formulations: From basic research to technological development. *Acta Tropica*, *212*, 105419. https://www.sciencedirect.com/science/article/abs/pii/S0001706X19311970

Akkari, H., Ezzine, O., Dhahri, S., B'chir, F., Rekik, M., Hajaji, S., Darghouth, M. A., Jamâa, M. L., & Gharbi, M. (2015). Chemical composition, insecticidal and in vitro anthelmintic activities of Ruta chalepensis (Rutaceae) essential oil. *Industrial Crops and Products, 74,* 745–751. https://doi.org/10.1016/j.indcrop.2015.06.008

Aluyor, E. O., & Oboh, I. O. (2014). *Traditional preservatives-vegetable oils*. ResearchGate. https://www.researchgate.net/publication/323813376_Preservatives_Traditional_Preservatives_-_Vegetable_Oils

Amar-Yuli, I., Bohlin, L., Borgheti-Cardoso, L. N., Brown, M., Burt, S., Callander, J. T., Chorilli, M., Dong, L., Drummond, C. J., Engström, S., Fonseca-Santos, B., Guo, C., Hammer, K. A., Jones, D., Jones, D. S., Katz, T. M., Khalil, R. A., Kim, S.-I., Kitagawa, S., & Carvalho, F. C. (2018). An effective mosquito-repellant topical product from liquid crystal-based tea tree oil. *Industrial Crops and Products*, *128,* 488-495. https://www.sciencedirect.com/science/article/abs/pii/S0926669018309956

Anggraeni, Indrayati, N., Hidayat, Wiani, I., Rachman, Ersanda, & Diana, S. (2018). Bioactivity of essential oil from lemongrass (Cymbopogon citratus Stapf) as antioxidant agent. *1st International Conference and Exhibition on Powder Technology Indonesia (ICePTi), 1927*(1). AIP Publishing. https://doi.org/10.1063/1.5021200

Avoseh, O., Oyedeji, A., N-keh Chungag, B., Rungqo, P. O., & Oyedeji, O. (2015). Cymbopogon species; ethnopharmacology, phytochemistry and the pharmacological importance. *Molecules, 20*(5), 7438-7453. https://doi.org/10.3390/molecules20057438

Aw, T. (2018). *Environmental aspects and features of critical pathogen groups*. https://www.waterpathogens.org/book/environmental-aspects-and-features-of-critical-pathogen-groups

Bakkali, F., Averbeck, S., Averbeck, D., & Idaomar, M. (2008). Biological effects of essential oils – A review. *Food and Chemical Toxicology, 46*(2), 446-475. *https://doi.org/10.1016/j.fct.2007.09.106*

Baldacchino, F., Tramut, C., Salem, A., Liénard, E., Delétré, E., Franc, M., Martin, T., Duvallet, G., & Jay-Robert, P. (2013). Parasite. *The repellency of lemongrass oil against stable flies, tested using video tracking*, *20,* 7. EDP Sciences. https://doi.org/10.1051/parasite/2013021

Brenda J. Reau, (2021). *Evaluating consumer acceptance of food products*. MSU Extension. https://www.canr.msu.edu/news/evaluating_consumer_acceptance_of_food_products

Brown, A. (2018). Science Alert. *Understanding food: principles and preparation. Cengage learning. Efficacy and residual activity of lemongrass essential oil (Cymbopogon flexuosus) against German cockroaches (Blattella Germanica),* 704. Google Books. https://rb.gy/5tob9

Cabarogias, A., & Nicolas, A. (2015). Indigenous knowledge and sustainable pest management in rice farming communities of Southern Luzon, Philippines. *International journal on advanced science, engineering technology, 5*(2015)*,* 149-154. https://ijaseit.insightsociety.org/index.php?option=com_content&view=article&id=9&Itemid=1&article_id=590

Cole-Parmer. (2020). *Solvent Extraction Method of Plants Using Ethanol*. Cole-Parmer. https://www.coleparmer.com/tech-article/solvent-extraction-method-ethanol

Creswell, J. W. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches, 5,* 304. Sage Publications. https://books.google.com/books/about/Research_Design.html?id=s4ViswEACAAJ

Fradin, M. (2019). Insect protection. *Travel medicine* (4th ed.*,* 6, pp. 43-52). ScienceDirect. https://doi.org/10.1016/B978-0-323-54696-6.00006-9

Govt. Philippines. (2010, July 15). *Philippines: Dengue in Digos City, davao del sur – Philippines*. ReliefWeb. https://reliefweb.int/report/philippines/philippines-dengue-digos-city-davao-del-sur

Hutchings, J. (2012). Journal of food quality. *The importance of visual appearance of foods to the food processor and consumer, 1*(3), 267-278. Wiley Online Library. https://doi.org/10.1111/j.1745-4557.1977.tb00945.x

Jannatan, R., Rahayu, R., Herwina, H., & Nasir, N. (2017). European journal of biological research. *Fumigant toxicity and repellency of citronella grass essential oil Cymbopogon nardus (L.) Rendle) to female and nymph German cockroaches (Blattella germanica),* 8, 1763-1769. ResearchGate. https://rb.gy/d7kpc

Katzer, G. (2007). *Oregano (Origanum vulgare)*. Oregano (Origanum vulgare L. https://restorativemedicine.org/library/monographs/oregano/

Khan, N. T. (2020). *Pharmacological importance of sage and oregano*. Pen Access Pub. https://openaccesspub.org/japst/article/1338

Khater, H. F., Shalaby, M. M., & AI-Kholy, R. M. (2019). Journal of Vector ecology. *Efficacy and repellency of some essential oils and their blends against larval and adult house flies, Musca domestica L. (Diptera: Muscidae), 44,* 256-263. Wiley Online Library. https://doi.org/10.1111/jvec.12357

Lake Norman Pest Control, (2023). *Top 10 herbs used as insect repellants*. https://www.lakenormanpest.com/top-10-herbs-used-insect-repellant

Leyva-López, N., Gutiérrez-Grijalva, E. P., Vazquez-Olivo, G., & Heredia, J. B. (2017). *Essential Oils of Oregano: Biological Activity beyond Their Antimicrobial Properties, 22*(6), 989. MDPI. https://doi.org/10.3390/molecules22060989

Mapossa, A. B., Focke, W. W., Tewo, R. K., Androsch, R., & Kruger, T. (2021). Mosquito-repellent controlled-release formulations for fighting infectious diseases. *Malar journal*, *20*(1), 165. Malaria journal. https://doi.org/10.1186/s12936-021-03681-7

Oldworldgardenfarms. (2021). *How to keep mosquitoes away from your patio & yard - with plants!* Old World Garden Farms. https://oldworldgardenfarms.com/2021/05/20/how-to-keep-mosquitoes-away/

Patel, H. (2022). *The multiple health benefits of oregano*. HealthifyMe. https://rb.gy/i4ycs.

Pavela, R. (2022). Insecticidal properties of several essential oils on the house fly (Musca domestica L.). *Phytotherapy Research*: *PTR, 23*(2)*,* 274-278. National Library of Medicine. https://pubmed.ncbi.nlm.nih.gov/17886229/

PhilAtlas. (2020). *Sinawilan, Municipality of Matanao, Province of Davao del Sur*. PhilAtlas. https://www.philatlas.com/mindanao/r11/davao-del-sur/matanao/sinawilan.html

Rahayu, R., Ahmad, E., Ratna, M., Tan, & Hariani. (2012). Present status of carbamate, pyrethroid and phenylpyrazole insecticide resistance to German cockroach, blattella germanica (Dictyoptera: Blattellidae) in Indonesia. *Journal of Entomology*, *9*, 361-367. Semantic Scholar. https://www.semanticscholar.org/paper/Present-Status-of-Carbamate%2C-Pyrethroid-and-to-in-Rahayu-Ahmad/a862903c0734402d8d3bb847e18b951b792f6ef7

Rahayu, R., Madona, W. R., Bestari, W., Dahelmi, & Jannatan, R. (2016). Resistance monitoring of some commercial insecticides to German cockroach (Blattella Germanica (L.) in Indonesia. *Journal of Entomology and Zoology Studies,* 4, 709-712. JEZS. https://www.entomoljournal.com/archives/?year=2016&vol=4&issue=6&ArticleId=1408

Regnault-Roger, C., Vincent, C., & Arnason, J. T. (2012). Essential oils in insect control: low-risk products in a high-stakes world. *Annual review of entomology, 57*, 405–424. Annual Reviews. https://doi.org/10.1146/annurev-ento-120710-100554

Rowles, A. (2023). *9 benefits and uses of oregano oil*. Healthline. https://www.healthline.com/nutrition/9-oregano-oil-benefits-and-uses

Shah, G., Shri, R., Panchal, V., Sharma, N., Singh, B., & Mann, A. S. (2011). Scientific basis for the therapeutic use of Cymbopogon citratus, stapf (Lemon grass). *Journal of advanced pharmaceutical technology & research, 2*(1), 3–8. National Library of Medicine. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3217679/

Sharififard, M., Alizadeh, I., Jahanifard, E., Wang, C., & Azemi, M.E. (2018). Chemical composition and repellency of origanum vulgare essential oil against cimex lectularius under laboratory conditions. *Journal of arthropod-borne diseases, 12*, 387-397. Semantic Scholar. https://rb.gy/ajxpn

Sritabutra, D., & Soonwera, M. (2013). *Asian Pacific Journal of Tropical Disease*, *3(4),* 271–276. Repellant activity of herbal essential oils against Aedes aegypti (Linn.) and Culex quinquefasciatus (say.). *Asian Pacific journal of Tropical disease, 3*(4), 271-276. ScienceDirect. https://doi.org/10.1016/s2222-1808(13)60069-9

Thamkaew, G., Sjöholm, I., & Galindo, F. (2020). A review of drying methods for improving the quality of dried herbs. *Critical reviews in food science and nutrition*, *61*(11)*,* 1763-1786. Taylor and Francis Online. https://www.tandfonline.com/doi/full/10.1080/10408398.2020.1765309

Tovar, L., Pinto, G., Wolf-Maciel, M., Batistella, C., & Filho, R. (2011). Short-path-distillation process of lemongrass essential oil: physicochemical characterization and assessment quality of the distillate and the residue products. *I&EC research, 50*(13), 8185-8194. ACS Publications. https://pubs.acs.org/doi/10.1021/ie101503n

U.S. Department of Health and Human Services. (2020, April). *Essential oils*. National Institute of Environmental Health Sciences. https://www.niehs.nih.gov/health/topics/agents/essential-oils/index.cfm

WebMD. (2020). *Oregano: Overview, uses, side effects, precautions, interactions, dosing and reviews*. WebMD. https://www.webmd.com/vitamins/ai/ingredientmono-644/oregano#:~:text=Oregano%20(Origanum%20vulgare)%20is%20an,thyme%2C%20marjoram%2C%20and%20basil.

Winzeck, S., Hakim, A., McKinley, R., Pinto, J. A. A. D. S. R., Alves, V., Silva, C., Pisov, M., Krivov, E., Belyaev, M., Monteiro, M., Oliveira, A., Choi, Y., Paik, M. C., Kwon, Y., Lee, H., Kim, B. J., Won, J. H., Islam, M., Ren, H., Robben, D., & Reyes, M. (2018). Original research. *ISLES 2016 and 2017-benchmarking ischemic stroke lesion outcome prediction based on multispectral MRI, 9*, 679. Frontiers in Neurology. https://doi.org/10.3389/fneur.2018.00679

Wu, W., Yang, Y., Feng, Y., Ren, X., Li, Y., Li, W., Huang, J., Kong, L., Chen, X., Lin, Z., Hou, X., Zhang, L., Chen, Y., Sheng, Z., & Hong, W. (2022). Study of the repellant activity of 60 essential oils and their main constituents against aedes albopictus, and nano-formulation development. *Insects, 13*(12). MDPI. https://www.mdpi.com/2075-4450/13/12/1077

Yoo, C. (2022). *12 mosquito repellant plants - garden design*. GardenDesign. https://www.gardendesign.com/plants/mosquito-repellant.html