Review on Study of Insecticidal Activity of *Cymbopogon citratus,* and *Aloe vera* against *Musca domestica*

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Abstract:

Musca domestica, commonly known as Housefly, being the most pervasive insect, has the potential to act as a mechanical vector in transmitting many diseases and can spread almost 100 diseases to humans and animals, including bacterial, protozoan, helminthic, and viral infections. The task of reducing the population of these insects is quite difficult. Usages of plant-based insecticides are advantageous over the chemical insecticides. Most parts of *Cymbopogon citratus*, commonly known as Lemon grass is being used for many plant-based medicines preparations, as repellent against many insects and pests. *Aloe vera*, a perennial plant of *Liliaceae* family, is widely employed in numerous medical treatments. In this review we look into these plants efficiency in acting as a repellent against house flies. Both the plants show antibacterial, antifungal and insecticide activity against wide variety of species. Use of these biopesticide is increasing in the modern age which will provide a wide area of study for research.

Keywords: *Musca domestica*, *Cymbopogon citratus*, *Aloe vera*, bio-insecticides

Introduction

Musca domestica, popularly known as the Housefly, is the most common fly seen around, which doesn't bite and has a worldwide distribution. It is thought to be an effective vector for the transmission of a variety of diseases [1]. It is the most prevalent fly that may spoil meals by causing damage to the foods. It has been discovered that it is capable of transmitting over 100 diseases to both humans and animals. Houseflies have been observed irritating livestock in rural locations. Even in metropolitan areas, they attack homes, fruit and vegetable markets, and cause significant spoiling. The decomposing debris, food, and human wastes are the primary feeding and breeding areas for these flies. Because they are found near both garbage and human habitat, the potential of disease spread is very significant [2]. Viral, bacterial, protozoan, and helminthic infections are among the diseases it can spread. In a study conducted in Japan, researchers discovered that these flies can also spread the *Escherichia coli* strain. *Enterovirus, polio*, coxsackievirus, diarrhea, typhoid, bacillary dysentery, shigellosis, and cholera are some of the viral illnesses it can spread. As a holometabolous insect, the house fly serves as a vector for a variety of lethal diseases, including helminth parasites, protozoan cysts, enteropathogenic bacteria, and even avian flu. It also has a role in the transmission of epidemic dysentery, diphtheria, and leprosy in people, as well as typhoid, fowl cholera, and anthrax in poultry and livestock. Because these insects are so

dangerous, it's vital to keep them under control. As a result, controlling these flies is very much necessary to safeguard public health [3].

Chemical pesticides have been employed in recent years to prevent the spread of diseases by houseflies. To control them, chemical insecticides such as organophosphates, organochlorides, and pyrethroids were administered. They also tried baited poison, lure and kill, fumigation, and volatile pyrethroids in the beginning. All of these, however, necessitated a large amount of personnel and screening facilities [3][4]. Long-term use of these chemical insecticides resulted in flies developing resistance to them. Non-target creatures are also harmed by chemical pesticides. Because several chemicals are used in the manufacturing process of these insecticides, they pollute the environment. Because of all of these factors, chemical pesticides are ineffective and harmful when employed. As a result, an alternate approach or a control agent, such as the creation or use of bio-insecticides, is very necessary. In recent years, plant-based insecticides have been considered and found to be superior to chemical pesticides. Because of the repelling properties of plants, these plant-based pesticides have a long history of use in Egypt, China, and India. We all know that plants create secondary metabolites such as terpenoids, which is the most common secondary metabolite that has a function in limiting adult and egg development, along with inhibiting housefly growth and reproduction [5]. Because such plants are found in nature and do not harm the environment when released, they are preferable to chemical alternatives. Plant natural components can be used directly or extracted and employed; when extracted, pure compounds with specialized functionalities can be obtained [6].

Plants contain many numbers of active components in them, which may have different functions based on the compound present. The advantage of plant-based insecticide with that of chemical insecticide is that, it is easy to manufacture, eco-friendly, highly effective, less cost, easily degradable and safe usage for both humans and environment. Plants generally contain secondary metabolites which utilizes different types of modes to act or inhibit various biochemical pathways of insects. They also inhibit their flying ability or biting capacity of the flies [4].

Lemon grass, also known as *Cymbopogon citratus*, from Poaceae family is a plant endemic to India and Sri Lanka. The herbaceous preparation, which has several medicinal benefits, is made from the various sections of the lemon grass plant. Bioactive components are classified as repellants, poisons, feeding deterrents, and growth regulators, among other things. The substances are mostly divided into five categories: 1) nitrogen compounds, 2) terpenoids, 3) phenolics, 4) Proteinase inhibitors, and 5) growth inhibitors. The bioactive chemicals major actions have been discovered to be defensive against insects, mosquitoes, and other Diptera flies. The proteins that are exposed on the ciliated dendrites of odor receptor neurons that are exposed to the environment, which are found on the antennae of the insects, detect the odors from plant extracts. The volatile components in the odorous plant extract will bind to the odorant receptors, which are specialized cells. The oil extracted from these leaves is used in the production of perfumes, cosmetics, soaps, candles, and insect repellents, among other things. Its repellent properties have been documented against a variety of agricultural pests as well as non-agricultural pests [7]. The presence of monoterpenes, which is the predominant component of *C. citratus* oil, contributes to its insecticidal effect. Alcohols, terpenes, ketones, aldehyde, and esters are some of the bioactive components found in lemon grass. Other phytoconstituents include Citral, Nerol, Geraniol, Citronellal, Terpinolene, Geranyl acetate, and Myrcene, which are found in essential oils. According to a study,

luteolin, quercetin, kaempferol, isoorientin 2-O-rhamnoside, and apigenin are among the flavonoids and phenolic substances discovered in the plant.Citral is another important component, which has been proven to have anti-mosquito fumigant properties (*Culex pipiens*). *Callosobruchus* spp. is likewise proven to be repellent to *Cymbopogon citratus*. Geraniol has also been discovered to be repellent against *Tribolium castaneum* and *Sitotroga cerealetta* [2][3].

TABLE 1–Different compounds from *Cymbopogon citratus*[2]

COMPOUND NAME	PERCENTAGE
Citral	32.49
Nerol	4.18
Geraniol	3.04
Citronellal	0.3
Terpinolene	1.23
Geranyl acetate	5.4
Myrcene	0.7
Limonene	6
Borneol	0.53
β Caryophyllene	1.5

Aloe vera is a perennial plant that belongs to the Liliaceae family, which includes 360 species. *Aloe barbadensis* is now commonly referred to as *Aloe vera*. Because of its therapeutic value, this plant is quite popular. Aloe is a rigid plant with lance-shaped gray-green leaves with small spines on them [8]. The leaves have a large amount of transparent, mucilaginous gel in them. Because this is a succulent, it includes 99.5%water, and the gel has 75 distinct components, including lignin, phenolic compounds, vitamins, minerals, enzymes, salicylic acid, sugars, tannic acids, and anthraquinones, among others[9]. Acaricidal activity was demonstrated by the extract of *A. vera* combined with acetone, which resulted in mortality after treatment. Spectroscopy and chromatography are used to identify the active bio components in *A. vera* [10]. The mosquito species *Aedes aegypti* has been seen to have a larvicidal effect from Aloe extract. Normally, the insecticidal function of aromatic plant leaves has been discovered, but some research studies have discovered that *A. vera* leaves can also have an effect on major crop-destroying pests such as *Tribolium castaneum*. It also has an acaricidal impact on *Tetranychus cinnabarinus* and *Panonychus citri*, according to certain research [11].It has also been discovered to have antimicrobial and antifungal properties. The plant *A. vera's* medicinal and insect or pest control properties are rapidly improving, but its production pace is modest. Because, this plant reproduces naturally through axillary shoots, however it is a slow process. As a result, stem node, shoot tips, and micro-shoots are used in in-vitro techniques to cultivate aloe plants in lab conditions [12].

TABLE 2 Different compounds from *Aloe vera* [10].

Class	Compounds
Carbohydrates	Mannan, Glucomannan, Galactan, Cellulose, Xylan.
Enzymes	Phosphoenol pyruvate, Alkaline phosphatase, lipase, catalase, oxidase.
Anthrones	Emodin, isobarbaloin, anthral, Aloin A and Aloin B, Aloe emodin, ester of cinnamic acid.
Inorganic compounds	Zinc, Sodium, Calcium, Copper, Iron, Magnesium, Manganese, Potassium, Chlorine.
Organic compounds and lipids	Triterpenoids, triglycerides, gibberellin, linolenic acid, lignin, salicylic acid, uric acid.
Amino acids	Lysine, proline, threonine, alanine, glutamic acid, leucine, tyrosine, valine.
Proteins	Lectin
Saccharides	Glucose, mannose
Vitamins	Carotene, folic acid, tocopherol, B1, B2, B6.

Lemon grass extraction methods

According to the procedure given by Adeniran and Fabiyi, steam distillation can be used for the extraction of lemon grass. Fresh lemon grass leaves can be picked and thoroughly washed with distilled water to remove all dirt. The oil should be dried with anhydrous sodium sulphate and stored in the refrigerator at 4ºCfor later use [13]. Some other methods employed in the extraction process include Soxhlet extraction which has been used by M.E. Ojewumi et.al. (2017). Soxhlet extraction is one of the most extensively used methods for extracting active chemicals from plants. Hexane and ethanol are the most commonly used solvents. GC-MS can be used to determine the concentration and components of essential oils. The Soxhlet extraction technique has proven to be one of the most effective and extensively utilized methods [14].

Antimicrobial role of lemon grass

Lemon grass is best known for its repellent activities against wide group of insects and also its antimicrobial properties. Mahmoud Mohamed Ali et.al (2017) in their research have tested the oil against bacteria *E. coli*, *Staphylococcus aureus*, *Salmonella typhi*, *Klebsella pneuemoniae*, which were sensitive and did not show any repellency against the oil. It also showed inhibition of growth of bacteria [15].

Extraction of *Aloe vera*

Percolation and Soxhlet extraction are two techniques for extracting *Aloe vera* leaves. To extract the active components from the leaf and gel, both procedures are effective. Soxhlet apparatus being the easiest method of extraction. The leaves should be treated with 96% ethanol for about 3 hours before being introduced into the Percolator tool in the percolation technique. Because of their efficiency and convenience of use, these two approaches are commonly employed [11][12]. Other

simple extraction methods include, the plant material can be air dried and powdered mechanically. This powder can be stored in a bottle with ethanol overnight for extraction. This later can be subjected to evaporation to obtain the remaining of the evaporate. And this powder can be re-suspended in ethanol, which can be stored in air tight container for later use [16].

Role of *Aloe vera* as antifungal, biopesticide

Jeyasakthy Saniasiaya et.al. (2017) shown antifungal activity of this plant against the pathogenic fungus species *Aspergillus* which has the ability to cause Otomycosis [12]. *Aloe vera*is also proven to be used effectively against larvae of *Aedes* spp. Romasepfani Lubis et.al. (2018) found that secondary metabolite compounds that are present in *Aloe vera* extract has the ability to act as toxic for mosquito larvae[11].

Efficiency of plant extracts on Larvae

The larvae of house flies can be acquired by raising adult flies. To feed these larvae with the nutrition they require, they can be housed on a Petri plate. The third instar larvae are mainly used to test the repellency efficiency. Different amounts of plant extract can be combined with diet and placed into Petri plates. N Rani et.al (2019) has used this method called as Pour-on method. They have observed that mortality of larvae with change in body color from white to black. And it was also seen that the larvae body was shrunken. Histopathological studies showed the formation of blisters and damage to the intestinal wall [2][3]. The percentage of reduction in the emergence of adult house flies can be used to determine the repellency percentage or efficiency. The extract's rate of inhibition on pupae leads in a lower percentage of flies emerging. Rate of inhibition is calculated using the following formula,

$$\% IR = \frac{(Cn - Tn)}{Cn} \times 100$$

Where Cn is the number of newly emerged flies in the Petri dish used as a control.
Tn is the number of flies in the Petri dish that received the plant extract treatment.

This method can be used to compute the percentage of inhibition rate at various concentrations of plant extracts. Triplicates can be used to obtain an accurate value. The Dipping method explained by Rashmi A. Morey is another way to use the plant extracts on the larvae [1].

Efficiency of plant extracts on adult house flies

The method to test the repellency against houseflies is explained by Rashmi A. Morey (2012). In this method the mature flies, regardless of sexes, will be released in a chamber with two conical flasks. For the adult fly repellency test, the control will just have milk, whereas in the test sample it will be blended with milk. The funnel will be placed over the conical flasks to keep the flies from flying out. The repellency formula is given by Campbell MM (1983) that was used to check the repellency after 24 hours.

$$Repellency\ \% = 100 \times \frac{(C - T)}{C}$$

The number of flies trapped in the control flask in 24 hours is C, while the number of flies trapped in the treated flask is T [1]. Nitin Chauhan described another method for testing repellency, which involves measuring the repellency of field-collected flies in a lab chamber made up of transparent containers. The functioning model, which has a volume of around 2 $\times 10^4$ cm^3 and an interconnecting channel, is made up of two equal chambers. The test sample and houseflies are kept in the first chamber. On filter paper, various concentrations of essential oils in various ratios can be applied. To determine the most powerful plant-insecticide, different ratios of the extracted solution might be evaluated. Filter paper should not be treated with essential oil in experiments where a control is used [17]. The repellency of both plants can be performed in five replicates, and the data obtained can be statistically analyzed using SPSS software. Analysis of variance through One-Way ANOVA can be carried out using Tukey's test where $p < 0.001$ and the result can be interpreted [4].

Conclusion

The repellency of *Cymbopogon citratus* and *Aloe vera* plant extracts on *Musca domestica* was shown to be directly proportional to the concentration of the extract applied on the house fly in this study. The presence of many active bio components in lemon grass was determined using Gas Chromatography analysis. Limonene (7.09%), Citral (21.03%), Eucalyptol (13.09%), Geranial acetate (large quantities), Citral (32.49%), and many more chemicals are present. The rate of death of the larvae was seen to increase as the extract concentrations increased [2]. The essential oil isolated from *M. piperita* has showed a high rate of repellency against *Musca domestica* in various trials [1]. They discovered that when this *M. piperita* was utilized in field studies, it reduced the flying capacity of these flies (number of flies per hour) on cattle and other treated areas. The impact of using essential oil on field flies was demonstrated in some studies [3]. The role of *Aloe vera* in the treatment of house flies is not well studied. Mosquitoes were effectively repelled by a mixture of *Aloe vera* and olive oil. Olive oil has a moisturizing effect on the skin [18]. The effects of *Aloe* on the larvae of *Aedes* species have been tested. The larvae were found to have a 50% mortality rate [11]. Some monoterpenes, such as limonene and menthol, were also found to repel house flies. *Aloe vera* alcohol extracts have also been demonstrated to help with fungal infections [12][17].

Many people used Malathion, a man-made chemical organophosphate, before employing eco-friendly bio-insecticides. However, its use can be harmful to humans, animals, and the environment. As a result, an alternate use was required, and bio-insecticides were used. The fogging action of lemon grass stems and leaves was discovered to work as a replacement for Malathion [19]. The use of bio-insecticides, particularly those derived from plants, has proved to give a high rate of success in controlling insects that carry dangerous diseases. Because they contain a large number of bioactive chemicals, these plants and their derivatives are the most important alternative agents to chemical insecticides. The toxicity of plant extracts has been demonstrated to be particularly effective against Dipterans in some investigations. These plant extracts are efficacious, cost-effective, and, most importantly, environmentally friendly [1]. The extracts from the *Cymbopogon citratus* and *Aloe vera* plants may be used in repelling the most active and danger vector *Musca domestica*.

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