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Effectiveness of Plant-based Repellents against different Anopheles Species: a Systematic Review

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Abstract: ***The deadliest pest that humans are aware of is the mosquito. One of the best ways to lower sickness is to avoid mosquito bites. In daily life, we utilize a variety of synthetic mosquito repellents; nevertheless, prolonged use of these repellents can pose health and environmental risks. Many plants have been utilized as fumigants, insecticidal agents, and repellents since ancient times. The majority of plants include phytochemicals that act as insect repellent, shielding them from numerous insect attacks. The study presented in this paper aims to create herbal insect repellent formulations that are both safe and effective. Insecticides used in the past included neem oil, camphor, orange peel powder, and orange seeds. There are numerous applications for the dehydrated peels of citrus fruits in pest management. An effective repellent is orange oil, which is derived from orange peels. Linalool, a widely used flavouring agent and ingredient in perfumes, exhibits insect repellent qualities in addition to its olfactory qualities. Furthermore, it has been included into flammable items and topical therapies. It can be used in place of synthetic repellent because it has little risk of negative effects and benefits human health. The purpose of our study is to look into the phytochemical extracts from herbal products' repelling properties.***
Keywords: Plant extract, essential oil, herbal, repellent, mosquito.

I. INTRODUCTION

Certain diseases including dengue, malaria, and chikungunya, which can have a severe negative impact on health due to an increase in mosquito breeding, are spread by mosquitoes. Therefore, it's critical that you lower mosquito concentrations around your house and other living places.

To kill or get rid of mosquitoes, the market is flooded with instruments and repellent products. However, it's thought that the majority of pesticides on the market include a high concentration of chemical substances that might lead to allergies and skin diseases. Now, you can use natural insect repellents if you don't want to use strong chemical agents to get rid of mosquitoes. Since ancient times, people have used plant-based repellents as a form of personal defense against various Anopheles species. An important resource for the creation of novel natural products that replace chemical repellents is knowledge about traditional repellent plants. Numerous research have documented the evidence of plant extracts or essential oils' repellant properties against malaria vectors across the globe. The purpose of this systematic study was to evaluate plant-based repellents' ability to deter Anopheles mosquitoes.

Additional plant essential oils that demonstrated good repellency with 8 hours of complete repellency against various Anopheles species included lavender, camphor, catnip, geranium, jasmine, broad-leaved eucalyptus, lemongrass, lemon-scented eucalyptus, narrow-leaved eucalyptus, carotin, cedarwood, chamomile, cinnamon oil, juniper, cajeput, soya bean, rosemary, niaouli, olive, tagetes, violet, sandalwood, galbanum, and Curcuma longa. Eco-friendly repellents against Anopheles species could be developed by combining essential oils and plant extracts. In the future, plant oils could be a good substitute for synthetic repellents because they are widely accessible, reasonably safe, and affordable.

II. BACKGROUND

A major cause of illness and mortality is still diseases spread by mosquitoes. 3.3 billion people are at risk of contracting malaria in 106 tropical and subtropical nations and territories, despite decades of efforts to suppress the disease.

In sub-Saharan Africa, low birth weight, stillbirths, and early infant mortality are among the major causes of maternal and pediatric morbidity and mortality.

Approximately 50 species of Anopheles mosquitoes, out of the 500 species known to exist worldwide, are capable of spreading malaria by the bite of a female mosquito carrying the infection. There is now no viable preventive method other than vector control available, nor is there an effective prophylactic anti-malarial vaccination. It has long been recognized that using repellents to shield humans from mosquito bites is a necessary component of an all-encompassing integrated program to manage insect-borne diseases. The majority of commercial repellents are made with chemical ingredients such dimethyl phthalate, allethrin, N, N-diethyl mendelic acid amide, and N, N-diethyl-metatoluamide (DEET). Chemical repellents have been shown to have negative effects on synthetic fabric and plastic, as well as toxic reactions like allergy, dermatitis, and neurological and cardiovascular side effects that are typically reported after improper application. As a result, it has been determined that these products are not safe for the general public's health and should be used with caution. In order to control mosquitoes, synthetic repellents containing chemicals have been used frequently, upsetting natural ecosystems and leading to the emergence of insecticide resistance. Since plants are a rich source of bioactive phytochemicals that are safe and biodegradable into benign byproducts and can be evaluated for insecticidal and mosquito-repelling properties, interest in plant-based repellents has increased recently. Numerous research have demonstrated the ability of plant extracts or essential oils to repel malaria vectors worldwide. The goal of the current systematic review was to identify plant-based repellents that are safe for humans to use and that offer consistent, long-lasting protection against Anopheles mosquito species.

III. ADVANTAGES

A. One-stop Protection

In addition to providing efficient interior protection, gels, lotions, essential oils, creams, and wipes based on mosquito repellent solutions also work well outside.

B. Mosquito Sprays Provide an Immediate Fix

The concentrated chemicals in bug sprays, such as DEET (Diethyltoluamide), are very powerful at deterring and eliminating mosquitoes. Apply it to the parts of the house where mosquito populations are particularly dense.

C. Malaria and other Infections are Guaranteed to be Safe

A potentially fatal illness called malaria is brought on by mosquito bites. even though it is treatable. However, by eliminating mosquitoes and other potential bothersome insects, mosquito repellent offers an immediate fix. Another useful strategy for reducing mosquito-borne illness is the use of personal protection measures (PPM), such as mats, bed nets, liquid vaporizers, and mosquito coils.

D. A Wide Range of Safety Options

Whether it's natural or synthetic, the nicest thing about utilizing mosquito repellent is that you can employ personal protection measures however you see suitable. Thus, you might choose to sleep under an insecticide-treated net (ITN) if you are allergic to pesticides or sensitive to specific kinds of lotions or gels in order to prevent.

IV. DISADVANTAGES

A. Utilizing Pesticides

Concentrated pesticides found in all synthetically manufactured mosquito repellents pose a serious to moderate risk to human health if inhaled or come into contact with. If you spend more time in the room, you can get nausea, vomiting, dizziness, respiratory issues, irritated stomach, and difficulties breathing.

B. Sprays, lotions, and gels Don't Hang Around

The use of mosquito repellent is also limited by its short-term effects. Gels, lotions, and creams must be reapplied to your skin when their effects fade, usually within a few hours. Thus, as you are getting ready for bed, you had better choose a mosquito repellent substitute.

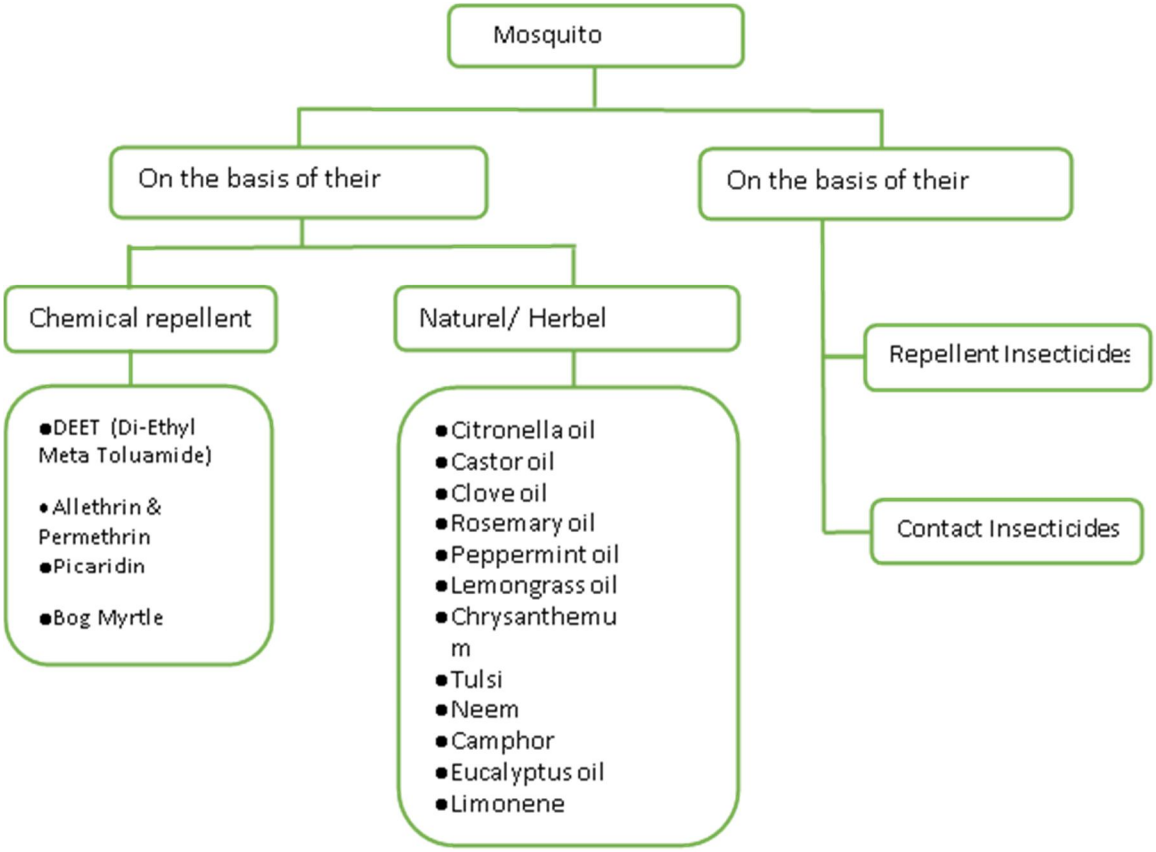
C. Incense and coils Generate Dust and Smoke

Coils have a 7–12 hour lifespan and can cause allergies and respiratory issues when smoked indoors. It is even possible for the smoke to induce lung cancer. To prevent mosquitoes from entering the room, coils should be positioned at all of the openings. Make sure the room it is in has enough airflow if you are putting it there.

D. Zappers Require a Backup Battery

You can use mosquito zappers indoors or outdoors; they don't produce any smoke or other harmful by products. The use of repellents for mosquitoes like these has a few drawbacks. It takes a lot of work to physically use the zapper to eliminate the hovering insects each time.

V. TYPES OF REPELLENT



VI. INGREDIENTS AND THEIR USE

Ingredients	Their use
Lemon eucalyptus	Cough relief, breath freshener, mosquito Repellent .
Clove	Mosquito repellent, Antiseptic, Flavouring agent ,Dental pain ,etc.
Peppermint	Mosquito repellent, sinus infection, headaches ,flavouring agent, etc.
Lemongrass	Flavouring agent ,mosquito repellent , analgesic ,antiemetic ,antiseptic, etc.
Basil	Constipation, antioxidant antimicrobial, anticancer, anti-inflammatory ,etc.
Neem	Antimalarial, antiviral ,antibacterial, antiviral, anti inflammatory,etc.
Eucalyptus	Anti-inflammatory , relieve congestion, anti malarial ,etc.
Catnip	Stress relief ,to trat insomnia, etc.
Thyme	Antibacterial ,flavouring agent, mosquito repellent, etc.
Camphor	Antiseptic ,analgesic, anti-infective ,anti-inflammatory ,etc.

VII. VARIOUS TYPES OF FORMULATION

A. *Lemon Eucalyptus oil Mosquito Repellent Spray*

Mix 10 milliliters of lemon eucalyptus oil with 90 milliliters of any carrier oil (such coconut or olive oil) to create an effective homemade mosquito repellent spray for your body. Apply the spray where needed after shaking the bottle. To lighten the spray, mix vodka and distilled water together. Because of the presence of chemicals like citronellal and p-methane 3,8-diol (PMD) in this essential oil, using lemon eucalyptus oil to repel mosquitoes is effective. For your DIY mosquito repellent spray, make sure to use only processed and purified lemon eucalyptus essential oil, as it contains trace levels of PMD.

B. *Neem oil and Coconut oil Mosquito Repellent Spray*

Neem oil is often used as a mosquito repellent because of the plant's potent scent and other natural qualities that deter mosquitoes. Studies have demonstrated that the combination of neem oil and coconut oil effectively repels mosquitoes.

To produce a fantastic herbal mosquito repellent, add 10 drops of neem oil, 30 ml of coconut oil, hot water, and vodka to a spray bottle. Spray the area as needed.

C. *Tea tree oil and Coconut oil Mosquito Repellent Spray*

Because tea tree oil has medical qualities, it can be an effective insect repellant. It can treat insect bites and has excellent antibacterial and anti-inflammatory qualities. It also works well as a herbal mosquito repellent due to its potent scent.

To prepare the best homemade mosquito repellent spray, fill a spray bottle with distilled water, vodka, and 10 drops of tea tree oil and 30 cc of coconut oil.

D. *Lavender oil, Vanilla and Lemon Juice Mosquito Repellent Spray*

Even though the scent of lavender oil is so relaxing and pleasant to humans, it may also be used to repel mosquitoes. This is due to the presence of naturally occurring mosquito-repelling substances in lavender oil, such as limonene, linalool, eucalyptol, and camphor. Lemon juice's acidic composition contributes to the mixture's ability to repel mosquitoes, and vanilla is another potent mosquito repellent. Fill your spray bottle with distilled water and add 10–12 drops of lavender oil, 3–4 tbsp of vanilla essence, and 3–4 tbsp of lemon juice. Use the combination as an effective natural insect repellent after shaking it.

VIII. PREVENTION

In order to restrict the spread of this deadly virus, individuals and families can make use of following measures to prevent themselves from contracting dengue at home

1) Use mosquito nets while sleeping. This is the easiest, most effective and a natural way to avoid getting bitten by mosquitoes.
2) Close windows and doors prior to dusk because mosquitoes are typically more active during and after dusk.
3) Wear clothing that completely covers your body and conceal yourself.
4) Since a clean environment inhibits mosquito proliferation, it is crucial to prevent all vector-borne diseases. Every day, mop and clean your home. Additionally, remove any standing or surplus water since they serve as mosquito breeding grounds.
5) Consume nutrients that help the body fight off infections before more immune system damage occurs.
6) Employ several strategies: Try using insect repellent spray with parathyroids in the evenings and at night, especially near sleeping places; cover all exposed body parts with lotions and creams.
7) If you are being isolated at home, make sure you are self-quarantined and keeping a social distance.
8) The use of mask and overall sanitization is important.

IX. SOURCES

Here is a list of 10 natural mosquito repellents that you can put to use and stop mosquitoes from invading your houses:

A. *Garlic Water*

Garlic water is considered one of the best ways to get rid of mosquitoes. You just need to crush a few cloves of garlic and then boil them in water. After that pour the solution in a spray bottle and spray it around your room, near all your outdoor light bulbs, garage, etc. This solution will kill mosquitoes instantly.Garlic is made up of several properties-so when you spray garlic water in your home it helps you to keep mosquitoes at bay.

B. Lemongrass

Lemongrass leaves are the most commonly found plants found in India. The lemongrass oil helps you to get rid of mosquitoes. You can use lemongrass oil or can crush the leaves and then applying the oily mixture directly to the skin. The protections from lemongrass oil can last several hours. So, one might feel the need to use lemongrass oil repeatedly since it is less concentrated.

C. Vinegar

Vinegar is one of the most easily available ingredients. Whether it is an apple cider vinegar or normal vinegar both can help you to get rid of mosquitoes. Take 3 cups of water and 1 cup of vinegar in a spray bottle and spray it on your skin. The spray can be sprinkled around the dining table and screen of the house also.

D. Lemon and Cloves

Half lemon and a hand full of clove work as a wonder ingredient to keep mosquitoes away. Take a lemon slice, insert some cloves in it and place it in a room. This magic ingredient will help you to keep mosquitoes away.

E. Lavender oil

Mosquitoes can't stand the scent of lavender oil! So you can use the Lavender oil to keep mosquitoes away. You can spray it around your home and surrounding areas. You can even put some on your body to avoid getting bit!

F. Basil

Basil or Tulsi is believed to be great for making tea but mosquitoes detest it. You can use basil as a multi-use mosquito repellent--you can place a plant on your windowsill to keep mosquitoes at bay, or even use it as a topical oil and apply it to your skin. It releases an odor that repels these pesky insects.

G. Camphor

Camphor is a versatile repellent-it's strong odor drives mosquitoes away. Take two tablets of camphor in about a quarter cup of water and spray it around your room or outdoor. For more effect, you can burn some camphor in the room and close all doors and windows and leave it burning for about 20 minutes. Stay outside the room; you will see the instant results.

H. Peppermint

Peppermint is another natural way to combat mosquitoes. To use Peppermint you just need to combine a few drops of peppermint essential oil with one cup of water in a spray bottle, shake well, and spray on your skin. This instant peppermint spray will not only help you to repel the blood-sucking beasts, but you'll also smell minty fresh!

I. Coconut oil and Neem Oil

A combination of coconut oil and neem oil works as a natural repellent. You just need to mixed coconut oil and neem oil together well with water and spray it on your skin. This will help you to repel mosquitoes for up to half a day.

J. Coffee Grounds

Coffee grounds can help keep mosquitos at bay. It not only an eco-friendly alternative, but it's a great way to reuse coffee grounds! You can simply burn some coffee grounds in a coffee tray or egg carton, and trust the smoke to repel these pests.

X. CONCLUSION

The findings of this study revealed that essential oils and extracts from certain plants have strong repellent action against Anopheles spp. mosquitoes. In the last two decades, researchers have been looking for novel natural repellents, and while certain plants have shown to have repellent properties, few natural products have been developed. Entomologists and individuals working in the field of mosquito-borne diseases should read this review to learn more about the usefulness and possible role of plant-derived repellents in disease control.

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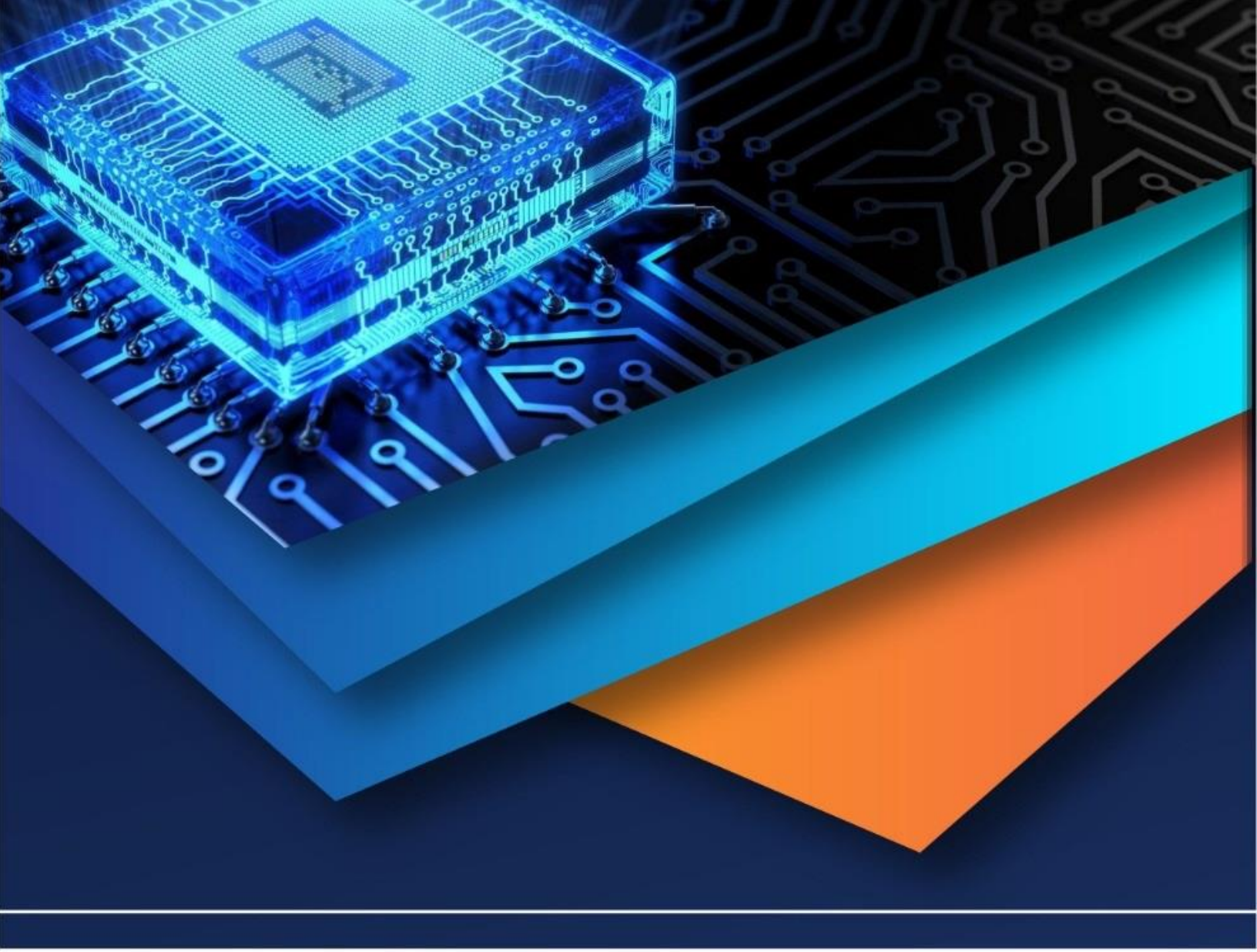

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