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# Formulation and Evaluation of Herbal Mosquito Repellent Gel

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## I. INTRODUCTION

1] Citronella oil - Cymbopogon Citrates
2] Aloe vera - Aloe Barbadensis.
3] Peppermint oil –Mentha Piperita.

Citronella oil is made from citronella grass. Sri Lanka citronella Grass is native to tropical areas. The essential oil is made through a process called steam distillation . during the process, steam is passed through the grass to pull out the oil .people most commonly use citronella oil as a mosquito repellent on the skin. It also used for other conditions, but there is no good scientific[1]

Mosquito Repellent Citronella oil to skin seems to prevent mosquito bites for a short period time . the concentration of the citronella oil seems to affect how well and how long protection lasts.higher concentration seems to last longer.[1]

Citronella oil safe for the pregnancy and breast feeding . citronella oil is possibly unsafe when taken by mouth in children. Malaria is caused by a parasite that is spread to human through the bite of an infected anopheles mosquito.[1]

**Cymbopogon Nardus (Citronella)**
Kingdom : Plantae
Order : Poales
Family : Poaceae
Genus : Cymbopogon
Species : C. nardus29

Cymbopogon nardus or Citronella grass (S. Pengiri) is a coarse and clump-forming tropical grass native to Sri Lanka. Citronella grass can grow up to 1.5-1.8 m tall and citronella stems are like canes. Citronella essential oil is extracted by steam-distillation of citronella leaves. Citronella essential oil is used as an insect repellent and it can be found in dozens of registered pesticide products such as sprays, lotions and candles.[2]

citronella oil is also used to treat insect bites. Additionally, citronella essential oil is one of the most common oils used in aromatherapy as it has an ability to treat and prevent fever and headache. The oil of citronella is also widely used in fragrances and personal care products. Because of citronella oil's antiseptic properties, it is used in soaps, household cleaners and detergents. Moreover, citronella oil is added as a food and beverage flavouring, such as in alcoholic drinks and frozen dairy. The main components of citronella essential oil are monoterpene hydrocarbons and alcohols such as geraniol (18-20%), citronellal (5-15%), citronellol (6.4-8.4%), limonene (9-11%) and geranyl acetate (2%). Additionally, methyl eugenol, camphene, nerol, borneol, citronellic acid and citral are also present in citronella essential oil.

**Types of Repellent –**Mosquito repellents are classed in a variety of ways. Depending on their source, they are categorized as chemical or herbal repellents. They can also be categorized according to how they act. Insecticides that repel insects and pests rather than killing or killing them are known as repellent insecticides.

Plant based repellent: Natural products have proven to be a rich supply of molecules for therapeutic development, with greater structural diversity on a bigger scale than synthesized compounds. Natural products have historically been important sources of bioactive compounds and will continue to be important in the development of novel medications .

**Synthetic mosquito repellents** - According to Brown and Hebert, the synthetic compound DEET (N, N-diethyl-mtoluamide) has been the most effective single insect repellent for many years and is the basis for many commercial mosquito repellent products on the market. Despite reports of major toxic qualities that can have a significant impact on adults and children, such as dermatitis, allergic reactions, neurological (seizures, coma), and cardiovascular toxicity, the likelihood of serious toxic consequences of DEET is deemed low. DEET, on the other hand, should be used at the lowest effective amount feasible. Effective mosquito repellents such as dimethyl and di-n-butyl phthalates (DMP and DBP, respectively)

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were widely used in the previous century but are no longer frequently advised due to their toxicity .

Plant based repellent: Natural products have proven to be a rich supply of molecules for therapeutic development, with greater structural diversity on a bigger scale than synthesized compounds. Natural products have historically been important sources of bioactive compounds and will continue to be important in the development of novel medications .

Some plants' essential oils and extracts could be used to create environmentally safe repellents against Anopheles species. Plant oils, which are reasonably safe, affordable, and widely available in many regions of the world, may one day serve as viable alternatives to synthetic repellents.

Plant essential oils such as lavender, camphor, catnip, geranium, jasmine, broad-leaved eucalyptus, Orange, lemongrass, lemonscented eucalyptus, amyris, narrow-leaved eucalyptus, carotin, cedar wood, chamomile, cinnamon oil, juniper, cajeput, soya bean, rosemary, niaouli, olive, shows good repellent properties.

**Basil** -Steam distillation in a Clevenger-style equipment was used to get the oils. Their chemical composition was determined via gas chromatography mass selective analysis. The antioxidant activity of these essential oils was determined using 1, 1-diphenyl-2- picrylhydrazyl assays; the tyrosinase inhibitory abilities of the given group of oils were also determined spectophotometrically; and the antimicrobial activity of the essential oils was determined using the agar diffusion method, with minimal inhibitory concentrations expressed

**Camphor**- Camphor is a common substance that can be used to kill mosquitoes in a home. When compared to other natural products, this substance, which is made from a tree extract, has the longest mosquito repellent effect. In a closed environment, burning camphor can be very efficient at repelling insects .

**Cedar**-The mosquito Aedes aegypti was not repelled by cedar wood oil .

**Chamomile**- The relaxing effects of dried chamomile leaves and flowers help to relax our nervous system and induce a deep natural slumber. Chamomile not only repels ticks and mosquitoes, but it also repels flies .

**Citronella** -Citronella is an essential oil derived from the leaves and stems of one of the lemongrass species of plants. Citronella oil is released when the leaves and stems of this plant are crushed, and it is utilised as a natural insect repellent. Citronella oil is used to repel mosquitoes in a variety of ways, including directly applying the oil, using infusers, and so on. Citronella (Cymobopogon nardus) is a common repellent component. Citronellal and geraniol, both of which repel pests, are abundant in this oil.

**Cinnamon**- Cinnamon is useful for more than simply applesauce and oatmeal. Cinnamon oil has been shown to kill mosquito eggs in a study conducted in Taiwan. Adult mosquitoes, particularly the Asian tiger mosquito, can be deterred by it.

Cinnamaldehyde, cinnamyl acetate, eugenol, and anethole, all of which are contained in cinnamon leaf oil, have been proven to be the most efficient against mosquito larvae. Filter paper diffusion and fumigation procedures were used to test the insecticidal and fumigant characteristics of C. cassia bark-derived compounds against the oak nut weevil (Mechoris ursulus).

**Clove**- Clove oil has been examined for its antibacterial, antimicrobial, and antifungal effects against cutaneous infectious symptoms, and has been found to be ecologically safe and harmless to people, making it suitable for usage in medicine, perfume, and food flavouring .

Respected authorities, such as the AAP, must endorse the proposal. For insect repellent needs, health care experts may be able to prescribe natural clove oil as an alternative to the currently suggested insect repellent DEET.

**Eucalyptus**- Water distillation in a Clevenger apparatus was used to extract Eucalyptus globulus essential oil. For the repellency test, Culicidae larvae were collected and adult mosquitoes were raised. The water titration method was used to prepare micro-emulsions of Eucalyptus globulus essential oil by mixing the prescribed surfactant (Tween 80 and Span 20) with the right amount of co-surfactant (propylene glycol).

**Geranium** -Because geranium oil isn't on the EPA's list of approved repellent substances, it isn't tested for effectiveness. It is, nonetheless, one among the most often used essential oils in natural repellents. Bite Blocker is a well-known brand that uses geranium. The effectiveness of this organic repellant has ranged from little over one hour to as much as seven hours in trials. The combination of rose geranium oil and coconut oil is thought to contribute to its effectiveness, albeit neither is as effective as DEET alone .

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**Jasmine -** Jasmine essential oil produced from Jasminum grandiflorum L. has been shown to repel mosquitos in experiments. Only three research have examined the mosquito repellent effectiveness of Roman chamomile essential oil, despite the fact that its chemical makeup has been identified.
Juniper In tests, jasmine essential oil derived from Jasminum grandiflorum L. was found to repel mosquitos. Despite the fact that the chemical makeup of Roman chamomile essential oil has been known, just three studies have looked at its mosquito repellent potential.
**Lavender** -Even though the smell of lavender oil is pleasant and comforting to humans, it may be used to repel mosquitoes. This is because lavender oil contains natural insect repellents such as limonene, linalool, eucalyptol, and camphor.
**Lemongrass** -Lemongrass is a citrus herb with a mild flavour. It's a common element in tea and a variety of Asian dishes. Researchers discovered that a blend of lemongrass essential oil and olive oil gave 98.8% protection against the southern house mosquito in a trial . During a field trial, Trusted Source discovered that a topical application of lemongrass essential oil offered 74–95 percent protection against two species of mosquitos for 2.5 hours .
**Lemon eucalyptus 85% citronellal is found in lemon eucalyptus essential oil. Because of its fresh aroma, it is a popular cleaning and cosmetics product**.
eucalyptus oil has been shown to protect against numerous types of malaria-carrying mosquitos as well as the yellow fever mosquito in both field and laboratory trials. According to a study, a combination with 32 percent lemon eucalyptus oil provided at least 95 percent mosquito protection for three hours. Because itdissipates more quickly than DEET, it provides less protection for a shorter period of time. Peppermint Another natural technique to repel mosquitoes is to use peppermint.
**Rosemary** -Rosemary leaf (Rosmarinus officinalis L) is a plant that contains geraniol, linalool, sineol, and burneol, among other essential oils. Essential oils are used to repel insects. This study focuses on a repellent test using Rosemary (Rosmarinus officinalis L) gel for Aedes aegypti mosquitos, with the goal of determining whether Rosemary (Rosmarinus officinalis L) can be used as a repellent preparation for Aedes aegypti mosquitos.
**Orange-**Important micronutrients, such as vitamins C and E, as well as carotenoids and flavonoids, are found in the human diet and are necessary for maintaining human health. Almost all plant material contains many dietary sources for these chemicals (65, 66). The presence of these functional food elements and antioxidant nutraceuticals or phytochemicals contributes to the nutritional value of foods. Phytochemicals are found in edible fruits and vegetables, and when consumed, they may help to regulate human metabolism and avoid chronic and degenerative diseases.

The beneficial roles of orange are as follows:
Antibacterial activity

- Source of vitamin C
- Antifungal activity
- Antioxidant activity
- Anti-Obesity activity
- Activity in cardiovascular system
- Protective of UV activity
- Relaxant, Sedative and Anxiolytic activities
- Insecticidal activity
- Orange oil can be used as green pesticides for biological pest control.

It is also used in various cosmetic formulations such as creams, lotions, perfumes, etc. Orange oil is said to have a variety of benefits in aromatherapy, including the ability to reduce stress, manage anxiety, facilitate relaxation, and improve mood. Citrus oils are composed up of extremely volatile terpenes and oxygenated molecules.

**1.1 Disease –**
**1.2 Malaria**
It is one of the most widespread disease caused by the plasmodium parasite**.**
It is serious ,life threatening and sometimes fatal human disease spread by mosquito**.**
The parasite is transmitted to human through the bites of Female Anopheles mosquito or infected mosquito.
**Causative Agent-**It is caused by a Plasmodium Parasite [Protozoa].
Their Varients1] Plasmodium Falciferum 2] Plasmodium Vivax. 3] Plasmodium Ovale.4] Plasmodium Malariae.
**Symptoms** – It can cause severe fever with chills fever high, Headache, Vomiting , Tachycardia, Nausea**.**
**Mode of Action –** It is a Transmitted through the Bites of Infected Female Anopheles Mosquitoes.
**Dignosis**- It is Diagnosed through Laboratory Blood test.

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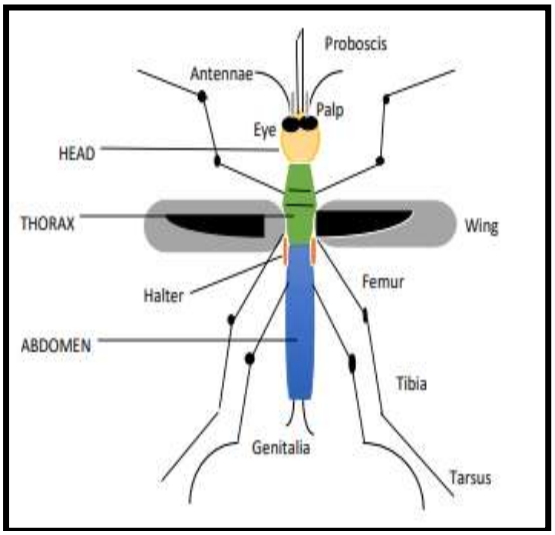
**Prevention And control of Malaria-**
Wear long Sleeves and trousers outside.
Mosquito Repellent Cream, and Spray, Gel ,should be use.
Screened window inhouse, use mosquito net burning of Mosquito coils.
Avoid beingbitten by a mosquito or avoid that affected area.

**Treatments**
- It is treated by using proper therapy of Antimalarial drugs.
-Quinolines – Quinine sulphate, Chlroquine, Pamaquine**.**
- Cycloquanil pamoate- Mefloquine, Primaquine etc.

**1.3] MORPHOLOGY AND ANATOMY OF MOSQUITO-**
Mosquito are ectoparasitic Insects. They have six definite legs, two antennae, hard shell, four wings and two eyes. The upper hard shell of mosquito called exoskeleton; it is made up of chitin which is solid hard proteins it prevents from dehydration.
Mosquitos Body Parts Consist of: -
1. Head
2. Thorax
3. Abdomen



**Fiq.No 1 Anatomy of Mosquito**

1. **Head:** - • Head of mosquito consist of different organs that are Antennae, Palps, Proboscis and Eyes.

v • Antennae are elongated cylindrical that detect the CO2 from the person's breathing
• Palps are the organs in the middle of the antennae and sense odor.
• Proboscis is also called mosquito's mouth which helps to find out blood vessel it makes easy for blood sucking
• Halter are small organs it helps for steering when mosquito is flying.
• Wings of mosquitoes are long, narrow and Mosquitoes has two wings
• Mosquito has six legs which consist of femur, tibia and tarsus are the end of legs help to stand and walk on water

**2. Abdomen**: - • Abdomen have long, narrow and 10 body segments connects thorax serves as stomach, reproductive system and respiratory system.

The malaria is caused by Protozoa from the genus plasmodium and transmitted to human through a bite of female Anopheles mosquitos. There are Three Stages – A. Pre – Erythrocytic Stage / Exo – Erythrocytic Stage: -

**1] Pre-Erythrocytic Cycle:** - • Malaria infection is initiated through the bite of infected female anopheles' mosquitos which release motile sporozoites into the human blood stream from its salivary glands.
• Then Sporozoites gets enter into the parenchyma cells of the host liver.
• This stage is symptoms free.

**2] Exo-Erythrocytic Cycle**: - • Through repeated nuclear divisions, Sporozoites multiply and develop into Schizonts.
• After the period of 8 – 21 days, liver cell ruptures due to multiple repeated division of Schizonts.
• This results in release of approximately 20,000 Merozoites into circulation. • In cases, Merozoites enter into the tissues and act as a reservoir of parasites.

**A. Erythrocytic Stage:** - • The Merozoites now enter into the blood circulation and invade the Erythrocyte / RBC

- .Some Merozoites invade fresh liver cell and repeat Erythrocytic Cycle.
- Inside this erythrocyte, the merozoites continue to grow.
- As Heam is toxic to malarial parasites, the Heam converts into the Hemozoin by decreasing the pH of RBC.
- In Erythrocytes, the Merozoites undergoes Asexual multiplication which results into formation of Erythrocytic schizonts.

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- Due to repeated multiplication of merozoites, Erythrocytes ruptures and release more Merozoites into the blood circulation
- Each Merozoites again invade fresh Erythrocyte and the cycle of asexual multiplication is repeated again.
- This cycle continues for about 48 – 72 hrs.
- It shows the symptoms like Shivering, Cold, Fever, etc.

**A. Sporogonic Stage: -•** After the Erythrocytic phase, Some of the Erythrocytic Merozoites develop into Male and Female Gametocytes by some undefined mechanism.

- Such infected blood when ingested by female anopheles' mosquitos, the sexual form of division. i.e.: - Gametocytes undergoes reproduction within the gut of insect.
- The resulting Zygote (Oocyte), through various stage of development give rise to the Infective Sporozoites.
- This Sporozoite get localized in the salivary gland of the insect and enter the host blood circulation. Then, Cycle goes on Repeating

**WHAT ATTRACTS MOSQUITO TO CERTAIN PEOPLE**

**1. Carbon-dioxide(co2)**

When people release (excrete) co2 while exhaling. This leads a indication to mosquito that the host is nearby.

**2. Body Odor**

The sweat associated with exercise and increase body temperature also called eccrine sweat is odourless to humans but not to mosquitos. Mosquitos not only smell sweat but they are also attracted to certain compounds present in sweat i.e. Lactic acid and ammonia (NH3).

**3. Body Temperature-** Increase in body temperature attracts mosquitos.

**4. Colour Mosquitos** are attracted to dark clothing (black, navy blue, red or orange).

**5. What you eat or drink** • Eating has an effect on your metabolic rate, which can increase body temperature and sometimes leads sweating.

• Alcohol consumption leads to more co2 release, more sweating and raises body temperature or sometime these 3 factors in combination results attraction of mosquitos.

**6. Pregnancy Mosquito** are attracted to pregnant women as they exhale more co2 and body temperature during pregnancy inc

## II. LITERATURE REVIEW-

**1] Singh Rajat Raghav et.al [2020]** - Medicinal plants contain various biologically active compounds that are useful for the improvement of a disease life and treatment and are the main source of synthetic and traditional herbal medicine. The presence of various lives sustaining constituents in plant made scientists investigate these plants for their uses. The objective of the work was to formulate a mosquito repellent gel containing natural ingredients which have their own advantages and benefits the formulation was made. Because in the market many chemical based formulations are present which having many side effects, so I make the formulation based on herbal ingredients which have no side effect of any age group of people. A volunteer's arms and legs rubbed with 1 ml solution of gel was exposed to 30 blood-seeking mosquitoes, and the number of mosquitoes that aligned orbiting the arm and legs were recorded in each minute for 5- minutes. And the analysis was carried out as a triplicate and mosquito repellent activities were found to be outdoor and indoor field trials on mosquito repellent gel active ingredients, which were conducted in three days from 7 am to 11 am by application on volunteers legs and arms. 100% mosquito repellency up to 4- hours was observed for the gel for outdoor and indoor field trials

**2] Salunke R Malti et.al [2022] -** Mosquito is a deadliest pest known to man. Prevention of mosquito bites is one of the best intervention methods to reduce disease. Various mosquito repellents are used in day to day lives which are synthetic and continue use of these repellents can cause health hazards and environment hazards. From ancient times various plants are used in form of repellents, fumigants and insecticidal agents. Most of the plants contain phytochemicals which they use as repellent in preventing attacks from various insects. The current paper summarizes research aimed at developing safe and effective herbal insect repellent compositions. In ancient times orange seeds and peel powder were used as insecticide. The dried peels of most citrus fruits have been used in various ways in controlling pest. Orange oil extracted from peels of orange can be used as repellent. It consists majorly Limonene a monoterpene which gives orange oil a peculiar odor and taste which shows repellent properties. Linalool which has perfumery property also shows repellent properties against insects which is widely used as flavoring agent and in production of perfumes. It has been also used in both topical

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preparations and combustible products as. It can be used instead of synthetic repellent as it has beneficial uses for humans in concern of health and low risk of side effects. Our study aims at investigating the repellent activity of phytochemical extracts (orange oil) from orange peels.

**3] Singhe Rana et.al [2013**] - The present study reports the studies directed towards the development of safe and efficient herbal mosquito repellent formulations obtained by mixing hexane extract of Azadirachta indica seeds, hexane/ethanol extract of Vitex negundo leaves, essential oils from Ocimum sanctum leaves, Curcuma longa rhizomes and Citrus sinensis peels and essential oils of Cymbopogon nardus leaves, Eucalyptus globules leaves and Syzygium aromaticum buds purchased from the market.

1 ml of 10% (v/v%) extract / essential oil containing ethanol solutions prepared using each plant extract / essential oil was tested for mosquito repellent activity using arm-incage method. A volunteer's forearm rubbed with 1 ml test solution was exposed to 20 blood-seeking mosquitoes and the number of mosquitoes that aligned or biting the arm was recorded in each minute for five minutes. Analysis was carried out as a triplicate and mosquito repellent activities were found to be in the order: Cymbopogon nardus and Eucalyptus globulus (100%) >Ocimum sanctum (97.94%) > Syzygium aromaticum (95.81%) > Citrus sinensis (93.75%) > Curcuma longa (89.56%) > Vitex negundo (85.44%) > Azadirachta indica (81.25%). Outdoor and indoor field trials on mosquito repellent gel and mosquito repellent spray prepared containing 16% (v/v%) active ingredients were conducted separately on two days from 5 am to 11 am by application on volunteers' legs. 100% mosquito repellency up to six hours was observed for the gel and the spray for outdoor and indoor field trials.

**4] Sharma Anil Kumar et.al [2013] -** Malaria is considered endemic in 104 countries and territories around the world nessessitating its control. Essential oils belonging to various plant species and possessing mixtures of hydrocarbons have been seen to act as effective repellent against various pests. The monoterpenoids constituting the major component is found to be cytotoxic to plant and animal tissue thus impairing the normal functioning of these tissues. The commercially marketed repellents basically consist of essential oils from plants Cymbopogon nardus, Eucalyptus maculata, Cymbopogon excavatus, Mentha piperita, Azadirachta indica. The volatile nature of these components due to their short duration of efficacy has urged for the development of novel formulations, use of fixatives such as vanillin and combination essential oil plants as repellents. The easy availability and less adverse environmental impact have led to the increased interest in plant origin insecticides as an alternative to chemical insecticides. The present article envisaged to review the reports of essential oils on its effectiveness as repellent. Keywords: Repellent, pesticide, mosquito, repellent, essential oil.

**5] Patel EK et.al [2016] -**Control of mosquitoes is something of utmost importance in the present day with rising number of mosquito borne illnesses. Deforestation and industrialized farming are also two of the factors causing an alarming increase in the range of mosquitoes. Specialty products like mosquito repellent used to combat mosquitoes are required. Each of the products used for mosquito control have varying degrees of effectiveness. Carbon dioxide and lactic acid present in sweat in warm- blooded animals act as an attractive substance for mosquitoes. The perception of the odor is through chemoreceptors present in the antennae of mosquitoes. Insect repellents work by masking human scent; a number of natural and chemical mosquito repellents were studied in this review that work to repel mosquitoes. Chemical mosquito repellents has a remarkable safety profile , but they are toxicity against the skin & nervous system like rashes, swelling, eye irritation, and worse problems, though unusual -- including brain swelling in children, anaphylactic shock, and low blood pressure. Hence it was concluded that natural mosquito repellents were preferred over chemical mosquito repellents.

**6] Singhe Rana MSN et.al [2017] -** The present study was conducted to determine the mosquito repellent activities of some selected plant materials in order to obtain safe and efficient herbal mosquito repellent formulations by combinations of the selected plant materials. Azadirachta indica1 seeds were socked in hexane overnight and extract was filtered and the filtrate was concentrated by rotary evaporator. Same procedure was carried out for Vitex negundo2 leaves using hexane and ethanol solvents. Hydro-distillation process was performed for Ocimum sanctum3 leaves, Curcuma longa4 rhizomes and Citrus sinensis5 peels using Clevenger-arm apparatus in order to obtain the essential oils.

Essential oils of Cymbopogon nardus4 leaves, Eucalyptus globulus6 leaves and Syzygium

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aromaticum1 buds were purchased from a reliable source. 10% (V/V%) extract/essential oil containing ethanol solutions were prepared using each plant extract/essential oil and mosquito repellent activity testing was carried out using arm-in-cage method. Volunteer's forearm which had been rubbed with 1 ml of the test solution was exposed to the cage where 20 blood-seeking mosquitoes had been placed and the number of mosquitoes that aligned or biting the arm was recorded in each minute for five minutes. Three replicates were carried out for each extract/essential oil containing ethanol solutions. After analysing the mosquito repellent activity of individual extracts and essential oils, a mosquito repellent gel and a mosquito repellent spray which contained 16% (V/V%) active ingredients each were prepared. Outdoor and indoor field trials were conducted in two days from 5 am to 11 am by separately applying the mosquito repellent gel and the mosquito repellent spray on volunteers' legs. The gel and the spray showed 100% mosquito repellency for outdoor and indoor field trials which were carried out for six hours each day for two days

**7] PRASUNA SUNDARI PJ*, CHATLA SUSHMA, et.al [2023]-**Herbal materials possessing mosquito-repellent activity were selected from the literature review based on percentage repellency and protection period. In this study, lavender, rosemary, lemongrass, and cedarwood oils were selected as actives. Span 20 and tween 80 were used to emulsify the volatile materials and then incorporated into Carbopol 934 base to form F1 and F2 gels which were evaluated for homogeneity, pH, spread ability, viscosity, and extrudability. Incense sticks were developed using charcoal and jigat as base materials. The prepared incense sticks F3 and F4 were evaluated for burning time, ash weight, and smoke. Solutions F5 and F6 were prepared using surfactants and cosolvents and were evaluated for phase separation. All formulations were screened for their mosquito repellency by screen cage method and their performance was compared to that of the marketed herbal repellents. Reared mosquitoes were identified as Culex species by microscopical observations of the antenna and maxillary palps. Mosquito repellency in 4 h is 93%, 87%, 89%, 79%, 89%, and 85% for F1, F2, F3, F4, F5 and F6, respectively. Among all, gel formulation F1 expressed the highest mosquitorepellent activity with 93% And is a better candidates.

**8] Singh SP and Lalit ,Mohan et.al [2022]-** Mosquitoes are blood-sucking insects that spread diseases including Malaria, Dengue, Japanese encephalitis, Yellow fever, etc. Humans must be protected from mosquito bites in order to avoid mosquito-borne diseases. The application of repellents such as lotions and liquidators to the skin or clothing creates a vapor layer with a disagreeable odor or taste that renders a person undesirable for feeding, therefore, repelling mosquitoes. Plant essential oils, in general, have been recognised as a major natural resource for repellents in this area because of their selective characteristics as they are biodegradable, non-toxic and eco-friendly. Textile-based mosquito repellents is one the popular method of protection using cotton, polyester and other textiles. This method requires no additional investment in textile finishing industry, which is a desirable feature in developing countries. This review details the efforts of technocrats who applied mosquito repellents to fabrics and the criteria used to determine repellency.

**9] Sharma Ruchi et.al [2019]-** Mosquito borne disease such as malaria , chikunguniya, yellow fever , Dengue and Japanese encephalalitis are the major cause of remarkable morbidity and mortality inLives stock and human world wide . since ancient times, Aromatic plant are used for there medicinal value Essential oil derived ; from these plants may be used as a effective alternatives / adjuvants in pharmaceuticals, biomedical, cosmetic, food, veterinary and Agriculture applications. These oils have also gained popularity and interest for the prevention and treatment of various disorders. Texture analysis and in vitro occlusive behavior and results were found satisfactory .

**10] Kumar Nitish et.al [2021] –**Citronella oil has been frequently used as an insect repellent and antibacterial agent for management of a vector born diseases. In the study ,the fabrication of citronella oil microsponge loaded hydrogel .[HG-COMS] was conceptualized in order to provide future insight for developing delayed release formulation the hydro gel was characterized for the drug content, drug interaction studies.Texture analysis and in vitro occlusive behavior and results were found satisfactory . further, in vitro antimicrobial studies were carried out to compare the antimicrobial inhibitory potential of the HG –COMS against citronella oil loaded

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hydrogel [HG-CO] .HG-COMS formulation showed better anti microbial efficacy than HG-CO [zone of inhibition of E.Coli, P.aeruginosa and S.aureus; with P value less than 0.01, 0.001 and 0.05 ,respectively]. In addition, safety [irritation potential] of the oil loaded hydrogel formulation was assessed by Hen's Egg test chorioallantoic membrane [HAT-CAM] method . mosquito Repellent activity against anopheles stephensi [malaria vector mosquito ] was also performed in a net cage having blood starved female mosquitoes. The repellent potential of prepared HG-COMS [34 percentage repellency for 6 hour] was found dependent on release of CO from the microsponges as well as from the gel matrix . HET-CAM test revealed that HG-COMS [irritation score ; 6.43-0.77] was found very promising in comparison to HG-CO [irritation score; 12.77 -0.36],and was thus ,considered safer for dermal use. HG-COMS showed reduced frequency of application , no skin irritation and potential for controlling A.stephensi for longer time periods .Hence, HG-COMS is found as a promising eco –friendly protective option, to minimize the burden of mosquito- transmitted diseases , especially malaria in future.

**11] Shivare Ruchi et.al [2018] -** DEET based mosquito repellents were found to be comparatively harmful to the person suffering from urea cycle disorders such as ornithine transcarbamylase (OTD) deficiency and, are therefore, contraindicated in individuals. These situations lead to the budding necessity of natural mosquito repellents which will have inexpensive, effectual, non-toxic, environment-friendly, and biodegradable attributes. Inspired from the upcoming global need, a carbopol 940 based mosquito repellant gel formulation was prepared from the essential oils of Cymbopogon nardus, Murraya Koenigii, Cymbopogon citratus, Tridax procumbens, Eucalyptus globules, and Azadirachta indica, and further evaluating them for their appearance, pH, viscosity, spreadability, extrudability, swelling index, and accelerated studies. The mosquito repellent potential was evaluated and simultaneously compared with the positive control (Odomos®). In several developing nations, where the majority of the people do not have access to mosquito net, high-cost mosquito repellant creams, and miscellaneous physical methods, this gel formulation may be an effective, inexpensive, and easily accessible way to prevent mosquito-borne diseases, like malaria, dengue, etc. in the lower sections of the society. Keywords: Mosquito, Repellent, Malaria, Gel, Formulation, DEET.

**12] Patil R. Jayesh et.al [2024] -**Nowadays Majority of the disease or infection like malaria, dengue etc. caused by the different types of mosquitoes mainly female Anopheles mosquito to prevent these infection or diseases there are multiple synthetic pesticides are used in market. The various pesticides used as a mosquito repellent containing hazardous chemicals that causes the various health problems in humans and other living creatures, that pesticides also cause the environmental pollution by considering these facts we are here with mosquito repellent without hazardous chemicals known as HERBAL MOSQUITO REPELLENT. As the herb are easily accessible in our society, it is very beneficial to use these Holly herbs in mosquito repellent formulations The herbs are the core substance in our formulations ,there are different active constituents such as alkaloids ,fixed oils, essential oil, resins flavonoids ,phenols etc. . Which is present in specific parts of herbs as it is extracted by various methods like steam distillation, pressing techniques, solvent evaporation etc. The current paper summarizes research with aimed of developing the safe and effective herbal mosquito repellents. Our study aims at the investigating the herbs which has mosquito repellent activity but they do not cause the health hazard, environmental hazard and pollution, those herbs which have Mosquito repellent activity which are used in specific proportion depending on their mosquito repellent activity in herbal mosquito repellent formulation and formulations have been developed.

**13] Patil Rahul, Kamate Poonam, et.al [2024]-** Mosquito-borne diseases remain a significant global health concern, necessitating effective and safe repellent solutions. This study explores the formulation of a gel-based mosquito repellent using extracts from Tridax procumbens (coat buttons), Cymbopogon citratus (lemongrass), and Azadirachta indica (neem). These plant species are known for their potent insect-repellent properties, attributed to compounds such as pyrethrins, citronella, and azadirachtin, respectively. The gel formulation was developed through a systematic extraction process followed by optimization of ingredient concentrations to enhance efficacy and stability. Physical and chemical characterization included viscosity measurements, pH determination, and stability testing under varying environmental conditions. In vitro testing against

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mosquito species known to transmit diseases such as malaria and dengue demonstrated significant repellent activity compared to control formulations. Furthermore, skin compatibility studies using human volunteers indicated minimal irritant potential, supporting its suitability for topical application. Overall, this mosquito repellent gel represents a promising alternative to synthetic repellents, harnessing the natural repellent properties of Tridax procumbens, Cymbopogon citratus, and Azadirachta indica while ensuring safety and efficacy for public health applications

**14] Bhat Sheetal et.al [2023]-**Mosquitoes are the vectors responsible for spreading different types of fatal human diseases such as malaria, Japanese encephalitis, dengue, filariasis, and yellow fever. It has been reported that mosquitoes are the vectors which alone are responsible for transmission of diseases to 700 million people and cause over 1 million deaths annually across the globe. These vectors have been considered as a major obstacle to socioeconomic development of developing countries particularly in the tropical region**.** The mosquitoes eject their saliva into the blood of the host that creates an immune response due to the binding of the antibodies IgG and IgE to the antigens. The reactions result in irritations, itching, redness and sometime it develops into the bumps. It is the saliva of the mosquito that often causes an irritating rash that is a serious nuisance. In addition, mosquito bites can cause severe skin irritation through an allergic reaction to the mosquito's saliva by human mosquito contact.

**15] Sharma HK et.al [2020] -** Mosquito are the two-winged blood sucking ectoparasite that are found in all over world. they cause serious health hazard problem in man or animals. Certain Species of mosquito would cause the many diseases such as malaria, dengue fever, Chikungunya, yellow fever etc. it is most serious problem for all over world. that disease causes death of millions of people. There are different 60- 70species of Anopheles mosquito that areresponsible for causing such a disease Out of that 30 vector are more important. According to WHO in 2020 there are estimated 241 million cases of malaria in worldwide, estimated number of malarial patient death up to 627000 in 2020. Malaria is major cause of death in world According to WHO Children dies from malaria every 30 seconds and 300 to 500 million cases occurred in every year

## III. AIM AND OBJECTIVE

**Aim-** Herbal Mosquito Repellent Gel Can Relief Mosquito Bite and Prevent against Mosquitoes that wide spread fatal human disease like Dengue, Malaria, and Yellow Fever.etc

**Objective -**

1. Mosquito Gel can provide protection all day indoors and outdoors.
2. Lifelong protection.
3. Free of any Harmful chemicals.
4. Skin Friendly.
5. Environmental Protection.
6. Easily Available.
7. Safe for kinds.
8. Safe for pregnant Women.
9. Aromatic in nature.
10. Cruetly free.

## IV. PLAN OF WORK-

- Literature Review.
- Selection of ingredients.
- Material and Methods.
- Formulation Development.
- Methods for Evaluation.
- Result and Discussion.
- Conclusion.
- References.

## V. SELECTION OF INGREDIENTS –

The selection of the plants was based on their availability as raw materials, scientific evidence and folkloric use as mosquito repellents

**1] Citronella oil-**Essential oils of Cymbopogon nardus (Citronella) leaves 8, 9 , Eucalyptus globulus (S. Eucalyptus) leaves 10 and Syzygium aromaticum (Clove) buds2 were purchased from Citro Essential Oils (PVT) Ltd, Sri Lanka.

**Properties of Citronella oil –**

1] Mosquito Repellency 2]Antiseptic

**Fig. no. 2: Cymbopogon Nardus.**

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**2] Aloe vera –**

Aloe vera gels were prepared according to the method described by Sameer et al. (17) First, washed, and air-dried Aloe vera leaves were cut in the middle lengthwise and the gel was obtained gently to avoid contamination with the sap of the leaf skin. Then the gel was subjected to grinding at room temperature (28±5°C) for 10 minutes to avoid browning followed by, filtration through a muslin cloth. The pH of the gel was adjusted to a value between pH 3.0 to 3.5 by adding citric acid.

**Properties –**

1] Moisturizer.
2] protect skin.
3] Heals wounds.
4] Reduce Acne.

**Fig. No. 3 Aloe vera**

**3] Peppermint Oil –**

Another natural technique to repel mosquitoes is to use peppermint. The Source came to the conclusion that large doses of peppermint essential oil are helpful, but no study on lower concentrations could be found (62, 63). Peppermint essential oil was found to be effective against mosquito larvae and to provide 100 percent protection against adult yellow fever mosquito bites for up to 150 minutes in a research.

**Properties**- cooling sensation

**Fig. No. 4 Peppermint Oil**

**4] Glycerin -**Glycerin (also known as glycerol) has many uses, including in food, medicine, and skincare.

**Food -**

- Thickens, sweetens, and preserves foods and beverages
- Improves the texture of confections
- Helps maintain moisture in baked goods
- Prevents icing from becoming too hard
- Used in low-fat foods like cookies


**Fig. No. 5 Glycerin**

**5] Propylene Glycol –**

Propylene glycol is a viscous, colorless liquid. It is used to absorb extra water and maintain moisture in certain medicines ,cosmetics, or food product.

**6] Triethanolamine –**

Triethanolamine is a viscous liquid widely used as a corrosion inhibitor, a surface-active agent and an intermediate in various products including metalworking fluids, oils, fuels, paints, inks, cement, cosmetic and personal products, as well as herbicide and algicide formulations.

**7] Turmeric-**

Turmeric is not only an insect repellent; it is also an effective cure for skin irritation caused due to bug bites. Apply a mixture of turmeric powder and rose water on the mosquito bite, and wash it off after 10 minutes.

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**Fig. No. 6 Turmeric Powder**

**8] Vitamin E Capsule –**

First to Avoid skin irritation Vitamin E Oil – Vitamin E is known for its skin healing properties and can help speed up recovery from mosquitoes bites related to disease .

**9] Carbopol 936 –**

Carbopol 936, a type of Carbopol polymer, is often used as a gelling agent in mosquito repellent gels. It provides benefits such as good extrudability, compatibility with essential oils, and a gel structure that aids in the long-lasting and effective application of the Repellent.

## VI. MATERIAL AND METHODS-

**Material** -The selection of the plants was based on their availability as raw materials, scientific evidence and folkloric use as mosquito repellents.

**Table no.3 The consistitute of Herbal Mosquito Repellent Gel.**

| The consistitutes | Quantity in Gel |
|---|---|
| 1] citronella oil | 10 ml |
| 2] Aloe vera | 10 gm |
| 3] pippermint oil | 5 ml |
| 4] Carbopol 940 | 1 gm |
| 5] Glycerin | 2.5 ml |
| 6] Triehanolamine | Few Drops |
| 7] Propylene Glycol | 2.5 ml |
| 8] Vitamin E Capsule | 1ml |
| 9] Termeric | As a Preservatives |
| 10] Distilled Water | Quality Sufficient |

**Methods-** Methods of mosquito control Mosquito-borne diseases affect millions of people worldwide each year. The bite of a mosquito can result in anything from a skin irritation to contracting malaria. Clearly, mosquitoes are not just a nuisance, but also potentially harmful. By taking measures such as wearing long pants in wooded areas or disposing of standing water, you can minimize the chances of attracting mosquitoes. These measures, however, are often not enough, and specialty products like mosquito repellent used to combat mosquitoes are required. Each of the products used for mosquito control have varying degrees of effectiveness, and it is important to know that some may be better than others.

## VII. FORMULATION DEVLOPMENT

**Method For Formulation Development-**

1. Prepare Citronella oil Mixture – Mix citronella oil with Propyleneglycol in small bowl.
2. Prepare carbopol Gel – Mix Carbopol 940 With Distilled water in a separate bowl.heat the mixture until the Carbopol dissolves.
3. Prepare the TEA Mixture – Mix TEA with Distilled Water in a Small bowl.
4. Combine the Mixture- Add The Citronella oil Mixture, Aloevera , Glycerin, and TEA mixture to the Carbopol Gel mix well.
5. Adjust the PH- Adjust the PH of the Gel to 5.5 – 6.5 using TEA or Citric Acid.
6. Add the Preservatives – Add The Preservative to the Gel and Mix well. Termeric using as Preservative.
7. Fill the and Pack – Fill the Gel Into a 50 ml Container and Pack it.

## VIII. EVALUATION PARAMETERS -

**1] PH Test-** Check the PH of the Gel to Ensure its within the range of 5.5 -6.5.

**2] Viscosity Test** – Within The range of 1000-5000 CP.

**3] Stability Testing** – Check the stability of the gel by storing it at room temperaure .for at least 6 months.

**4] Skin Irritation Test** – No significant Skin Irritation or Sensitization was observed in human subject.

**5] Efficacy Testing** – The mosquito repellent gel showed a significant reduction in the mosquito bites compared to the control group . the average protection time was 4-5 hours.

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## IX. RESULT AND DISSCUSSION -

**Result-**

| Physiochemical Properties | Result |
|---|---|
| 1] Colour | Pale Yellow Colour |
| 2] PH | 5.5 – 6.5 |
| 3] Odour | Pleasent |
| 4] Skin Irritation | No Significant Human Subject |
| 5] Efficacy testing | Protection Time 4-5 hour |
| 6] Texture | Smooth gel easily Spread in the skin |

**Disscusion –**

Plants as alternative source of repellent agent reported in numerous ethno botanical evaluation. They have been used traditionally in many parts of the world. The repellent properties of plant essential oils to mosquitoes and insects were well known before the advent of synthetic chemicals. Plant-derived repellents usually do not pose hazards of toxicity to humans and domestic animals and are easily biodegraded. Compared to synthetic compounds, natural products are presumed to be safer for human use. Moreover, in contrast with synthetic repellents which pose environmental threat, lethal effects on non target organisms and the resistance of mosquitoes to insecticides have increased during the last five decades, the natural products.

Novel mosquito repellent device of essential oils have greater scope in lieu of the fact that in twenty first century also mosquito borne diseases are affecting a large population worldwide. Essential oils because of their volatility act for a short duration. Polymeric slow release device containing essential oils can be one option for making them long acting. Also multiple emulsion with essential oil core may be a smart delivery system. Such topically applicable formulations will be convenient for people to apply and terminate. Essential oils abundant in nature and apart from its medicinal and flavor value, its use in repelling mosquito can be considered as sustainable and biocompatible delivery device as green alternative.

## X. SUMMARY AND CONCLUSION-

**Summary-** Herbal Mosquito Repellent Gel Are a natural alternative to chemical –based products. They oftain contain Plant – Based ingredients like citronella, Lemongrass, and peppermint, which hve been Shown To Repel Mosquitoes.

They Products Can Be a Safer and more Environmentally Friendly option, but their efficacy and duration of protection can vary.

**Conclusion-**

**1] Promising Natural Alternative-** Herbal Mosquito Repellent Gel Show Promise as a natural alternative to Chemicals based product**.**

**2] Variable efficacy-** The Efficacy of Herbal Mosquito Repellent Gel Can Vary Depending on the ingredients and formulation.

**3] Need of futher Research-** futher Reseach is needed to fully understand the efficacy and potential benefits of herbal mosquito repellent gels.

**4] Improtance of proper formulation-**Proper Formulation and Quality control are crucial to ensure the efficacy and safety of herbal mosquito repellent gel.

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