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FORMULATION AND EVALUATION OF MOSQUITO REPELLENT PAPER FROM LANTANA CAMARA

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ABSTRACT :-

This study aimed to explore the mosquito-repellent properties of smoke generated from Lantana camara when dissolved in various solvents, including methanol, ethyl acetate, ethanol, and diethyl ether. The methodology involved drying the plant samples, followed by combustion to produce smoke, which was then extracted using the aforementioned solvents. The resulting extracts were concentrated using a rotary evaporator, and a series of repellent concentrations ranging from 50 ppm to 1000 ppm were prepared for evaluation.

Among the different extracts tested, the methanol extract at a concentration of 400 ppm demonstrated the most significant efficacy, providing substantial protection against bites from female Anopheles mosquitoes ($P > 0.01$) for a duration exceeding 300 minutes. This particular extract not only yielded the longest protection time but also exhibited a consistent level of repellency over an extended period compared to the other solvent extracts. The findings of this research indicate that Lantana camara has the potential to serve as an effective natural repellent against Anopheles mosquitoes, marking a significant advancement in the development of safe, organic repellents aimed at controlling malaria transmission by these vectors.

Despite the promising results, further investigations are warranted to isolate and identify the specific chemical compounds responsible for the observed mosquito-repelling effects. Understanding the structures of these compounds and their mechanisms of action will be crucial for optimizing their use in repellent formulations and enhancing their effectiveness in practical applications.

Keywords: Anopheles mosquito, repellents, Lantana camara, smoke, leaves.

INTRODUCTION:-

Lantana camara, commonly recognized as a weed, is a vigorous shrub characterized by its low-erected growth, recurved prickles, and a distinctive strong blackcurrant odor. This plant typically reaches heights of 1 to 2 meters and thrives in both subtropical and tropical regions, often flourishing at elevations of up to 2000 meters. Globally, L. Camara is regarded as one of the most significant medicinal plants due to its diverse range of bioactive compounds and traditional uses .

Female Anopheles mosquitoes are a major public health concern, particularly in sub-Saharan Africa, as they are the primary vectors responsible for the transmission of malaria. To effectively combat malaria, it is crucial to minimize contact between these vectors and humans. One of the key strategies in malaria prevention is the use of mosquito repellents. Although synthetic chemicals and insecticides have been widely employed to control mosquito populations, their use has led to severe ecological damage, as many of these substances are non-degradable and can have long-lasting effects on the environment.

Despite ongoing efforts to eliminate malaria, it remains a significant global health issue, ranking among the top six deadly diseases worldwide. Each year, approximately two million children and pregnant women succumb to malaria, underscoring the urgent need for effective prevention strategies. The primary mode of transmission is through female Anopheles mosquitoes, and while various control measures have been proposed, success has been limited due to the development of resistance among mosquito populations to conventional treatments.

Research has indicated that certain plant compounds can serve as effective mosquito repellents against various species of Anopheles and Culex mosquitoes. The presence of harmful microbes, such as Plasmodium falciparum, in mosquitoes makes them particularly undesirable, as they pose a significant health risk to humans.

Numerous studies have documented the adverse effects associated with synthetic mosquito repellents. For instance, synthetic pyrethroids, such as allethrin, disrupt sodium channel function, leading to abnormal excitability in insects.reported that exposure to mosquito coil smoke over a prolonged period resulted in significant respiratory issues in rats, including focal deciliation of the tracheal epithelium and alterations in alveolar macrophages. Additionally, found that neonatal exposure to DDT and subsequent treatment with bioallethrin caused irreversible changes in muscarinic acetylcholine receptors in the cerebral cortex of mice, leading to behavioral disturbances.

Synthetic repellents can also cause skin and eye irritation, unpleasant odors, and allergic reactions, while remaining toxic to various life forms for extended periods. Chemicals such as N,N-diethyl-m-toluamide (DEET) and dimethyl phthalate (DMP) have been widely used as mosquito repellents but have

raised safety concerns due to their toxicity. Despite extensive efforts to prevent mosquito bites and the transmission of diseases, mosquitoes continue to infect over 700 million people annually, resulting in approximately one death for every seventeen individuals alive today.

The first plant-based mosquito repellent was developed in 1990 at the University of Florida. Natural products are increasingly viewed as suitable alternatives for mosquito control due to their renewable nature, high biodegradability, and minimal toxicity to non-target organisms. Therefore, there is a pressing need for comprehensive research to identify and develop eco-friendly biological repellents for mosquito control . Plant- derived phytochemicals have demonstrated various insecticidal properties, including acting as repellents, antibiotics, larvicides, and insect growth regulators.

Traditionally, phytochemicals have been utilized in many cultures to repel and eliminate mosquitoes. Lantana camara, in particular, has shown significant potential as a mosquito repellent. highlighted the repellency of L. Camara flowers against Aedes mosquitoes, demonstrating that an extract in coconut oil provided 94.5% protection against Aedes albopictus and Aedes aegypti, with an average protection duration of 1.9 hours. The current study aims to evaluate the repellency of smoke extract from L. Camara leaves in cream form against female Anopheles mosquitoes.

In addition to its repellent properties, Lantana camara has been used in traditional medicine as a tonic and stimulant. The plant has also been investigated for its insecticidal properties against various insect species, demonstrating anti-oviposition and growth-regulating effects. This study seeks to further explore the potential of L. Camara as a natural mosquito repellent, contributing to the development of sustainable and environmentally friendly alternatives for vector control

LITERATURE SURVEY :-

- **Madhav et al., 2024** : Mosquitoes are one of the primary vectors for disease transmission, significantly impacting public health, especially in tropical regions such as Indonesia. Several mosquito species from the genera Anopheles, Culex, and Aedes act as carriers of viruses that cause a range of diseases, including yellow fever, chikungunya, dengue fever, dengue hemorrhagic fever, filariasis, Japanese encephalitis, and malaria.

- **Venu et al., 2023** :Efforts to control mosquito populations using chemical insecticides have shown significant results. However, long-term use of these insecticides has led to adverse outcomes, including mosquito resistance to active ingredients and harmful impacts on the environment and human health.

- **Edy & Parwanto, 2020** : Lantana camara, commonly known in Indonesia as tembelekan, has long been used in traditional herbal medicine and is increasingly recognized for its potential as a natural vector control agent. The leaves of L. camara contain bioactive compounds such as flavonoids, alkaloids, terpenoids, steroids, polyphenols, and tannins.

- **Mondal et al. 2023** : emonstrated that L. camara leaf extracts had a higher larvicidal potential than flower extracts, with an LC50 of 5.01 ppm for Culex quinquefasciatus larvae. These findings support the current study's results, emphasizing the effectiveness of L. camara leaves as a primary ingredient in repellent formulations.

- **Abbas et al. 2024** : the repellent effects of L. camara are effective but typically require more frequent reapplication than chemical-based products, which showed that L. camara essential oil provided 100% protection against Culex quinquefasciatus at specific concentrations.

- **Bhargava et al., 2013** : The formulation of mosquito repellents from plant extracts can take various forms, including creams, sprays, and lotions. The choice of formulation affects the stability, efficacy, and user acceptability of the repellent. Research has shown that incorporating Lantana camara extracts into oil-based formulations can enhance their repellent properties and prolong their effectiveness.

- **Ahlbom et al., 2020** : Safety assessments of plant-based repellents are crucial for their acceptance and use. Studies have indicated that Lantana camara extracts exhibit low toxicity to non-target organisms and have minimal skin irritation potential. However, further dermatological evaluations are necessary to ensure the safety of formulated products for human use.
- **Rajan & Varghese, 2017** :Testing demonstrated a clear correlation between increased extract concentration and reduced mosquito bites, consistent with prior studies that have verified the efficacy of L. camara as both a repellent and a larvicide.

- **Hemalatha et al., 2015** :Various solvent extracts from L. camara aculeata leaves are effective against the larvae of Aedes aegypti, Anopheles stephensi, and Culex quinquefasciatus, with phytochemical screening revealing the presence of multiple bioactive compounds.

- **Alghamdi, 2021**:L. camara has insecticidal properties. Previous research has indicated that L. camara leaf extracts exhibit significant larvicidal bioactivity against Anopheles arabiensis and Culex quinquefasciatus mosquitoes.

NEED OF STUDY :-

The study of the formulation and evaluation of herbal mosquito repellents, particularly using Lantana camara, is essential for several reasons. Below is a detailed overview of the need for such studies, including the significance, potential benefits, and areas of focus.

Significance of Lantana camara

Botanical Properties: Lantana camara is a flowering plant known for its aromatic properties. It contains various phytochemicals, including essential oils, flavonoids, and terpenoids, which have been shown to possess insect- repelling properties.
Traditional Use: In many cultures, Lantana camara has been used traditionally for its medicinal properties, including its use as a natural insect repellent. Studying its efficacy can validate these traditional practices scientifically.

Health and Safety Considerations

Natural Alternatives: With growing concerns about the safety of synthetic repellents (e.g., DEET), there is a pressing need for natural alternatives that are effective and safe for human use. Herbal repellents like those derived from Lantana camara can provide a safer option for consumers, especially for children and pregnant women.
Reduced Toxicity: Herbal formulations are generally less toxic to humans and pets compared to synthetic chemicals. Evaluating the safety profile of Lantana camara can help establish it as a viable alternative.

Formulation Development

Optimal Concentration: Research is needed to determine the optimal concentration of Lantana camara extracts that provide effective mosquito repellent activity. This involves exploring various extraction methods (e.g., steam distillation, cold pressing) and solvent systems to maximize the yield of active compounds.
Formulation Techniques: The study can focus on different formulation techniques, such as emulsions, gels, or sprays, to enhance the stability and efficacy of the repellent. The choice of formulation can significantly impact the release and duration of the active ingredients.

Efficacy Evaluation

Laboratory Testing: Conducting laboratory tests to evaluate the efficacy of Lantana camara-based repellents against common mosquito species (e.g., Aedes aegypti, Anopheles gambiae) is crucial. This can involve both olfactometer tests and field trials to assess the repellent activity.
Duration of Protection: Evaluating how long the repellent remains effective after application is essential for consumer usability. Studies should measure the duration of protection and compare it with synthetic alternatives.

Consumer Acceptance and Market Potential

Consumer Preferences: Understanding consumer preferences regarding scent, texture, and application methods can guide formulation development. Surveys and focus groups can provide insights into what consumers look for in herbal repellents.
Market Trends: The demand for natural and organic products is on the rise. A successful formulation of Lantana camara-based mosquito repellent can tap into this growing market, providing a sustainable and eco- friendly alternative.

Environmental Impact

Sustainability: Lantana camara is often considered an invasive species in many regions. Utilizing this plant for mosquito repellent formulations can contribute to its management while providing an eco-friendly product.
Biodegradability: Herbal repellents are generally more biodegradable than synthetic options, reducing their environmental impact. Evaluating the environmental benefits of using Lantana camara can further support its use.

AIM :-

FORMULATION AND EVALUATION OF MOSQUITO REPELLENT PAPER FROM LANTANA CAMARA

OBJECTIVES :-

1. To Extract Bioactive Compounds:
    - To extract and identify the bioactive compounds present in Lantana camara leaves using various solvent extraction methods (e.g., methanol, ethanol, ethyl acetate).
2. To Formulate Mosquito Repellent:
    - To develop a mosquito repellent formulation using the extracted compounds from Lantana camara leaves in various forms (e.g., cream, spray, or lotion) and optimize the formulation for stability and efficacy.

3. To Evaluate Repellent Efficacy:
    - To assess the repellent efficacy of the formulated product against female Anopheles and Culex mosquitoes using standardized methods (e.g., arm-in-cage or choice tests) at different concentrations.
4. To Determine Duration of Protection:
    - To measure the duration of protection provided by the formulated mosquito repellent against mosquito bites over time, comparing it to commercial repellents.
5. To Analyze Safety and Skin Compatibility:
    - To evaluate the safety and skin compatibility of the formulated repellent through dermatological tests, including skin irritation and sensitization assessments.
6. To Conduct Phytochemical Screening:
    - To perform phytochemical screening of the Lantana camara extracts to identify the specific compounds responsible for mosquito repellency and their potential mechanisms of action.
7. To Assess Environmental Impact:
    - To analyze the environmental impact of using Lantana camara as a natural mosquito repellent compared to synthetic alternatives, focusing on biodegradability and toxicity to non-target organisms.

PLAN OF WORK

1. Literature review
2. Collection of all ingredients required for preparation
3. Material and method
4. Formulation of mosquito repellent paper
5. Evaluation of mosquito repellent paper
6. Future scope
7. Conclusion
8. References

MATERIAL AND METHOD :-

MATERIAL:-

Ingrediants:-

1. Lantana camara leaves powder
2. Camphor
3. Coconut oil
4. Rough paper
5. Potato starch

1. Lantana camara :-

- **Common Names**: Lantana, Shrub Verbena, Wild Sage
- **Family**: Verbenaceae
- **Description**: Perennial shrub (3-6 feet tall) with opposite, ovate leaves and colorful clustered flowers (yellow, orange, pink, purple).
- **Habitat**: Thrives in tropical/subtropical regions, prefers well-drained soils.

Chemical Constituents

- **Essential Oils**: Contribute to aromatic properties.
- **Flavonoids**: Antioxidant compounds (e.g., quercetin, kaempferol).
- **Triterpenoids**: Potential anti-inflammatory and antimicrobial effects.
- **Phenolic Compounds**: Medicinal properties.
- **Alkaloids**: Possible pharmacological effects.

Uses

1. **Medicinal**: Anti-inflammatory, antimicrobial, treats respiratory issues, and skin disorders.
2. **Insect Repellent**: Effective against mosquitoes and other insects.
3. **Ornamental**: Popular in landscaping for colorful flowers.
4. **Erosion Control**: Stabilizes soil in erosion-prone areas.
5. **Wildlife Habitat**: Attracts pollinators like butterflies.

Fig no.01:lantana camara

2. Camphor:-

Common Name: Camphor

Scientific Name: Cinnamomum camphora

Family: Lauraceae

Uses:

Pain Relief: Topical ointments for muscle and joint pain.

Respiratory Relief: Alleviates coughs and congestion when inhaled or applied. Antiseptic: Exhibits antibacterial properties for wound care.

Aromatherapy: Provides calming effects in essential oils.

Cosmetics: Used in creams and lotions for fragrance and skin benefits. Insect Repellent: Effective

against certain insects and pests.

Fig no.02:camphor

COCONUT OIL:-

Fig no.03:-coconut oil

Synonyms : Copra Oil

Biological Source: Cocos nucifera {Coconut Palm} Family : Arecaceae
Part Use :Dried Coconut Meat {Copra}

Chemical Constituents : Lauric acid, myristic acid , Oleic acid Use : Soap making, Skin care

Potato starch :-

Common name: Potato tuber Scientific Name: Solanum tuberosum
Family: Solanaceae (Nightshade family)

Uses

Food: Thickener, binder, gluten-free baking Pharma: Tablet binder/disintegrant
Textile & Paper: Sizing, strengthening

Fig no.04:-

Potato starch powder Bioplastics: Eco-friendly packaging
Adhesives: Ingredient in glues and pastes

METHOD:=

Sheat formulation Method

Description:

Paper strips are treated with essential oil, dry leaves and combustible binders so they can be burned like incense.

- Effect: Smoke contains mosquito-repelling compounds.
- Used In: Outdoor or semi-enclosed areas.

Advantages:

- Uses natural ingredients.
- Inexpensive and simple to prepare.
- Effective in outdoor environments.
- Portable and easy to use.

FORMULATION OF MOSQUITO REPELLENTS PAPE

SR. NO	INGREDIENTS	FUNCTION	QUANTITY
1	Lantana camara leaves dried powder	Mosquito repellent	50 gm
2	Potato starch	Binding agent	20 gm
3	Coconut oil	Carrier	10 ml
4	Camphor	Burning agent	10 gm
5	Paper pulp	Burning and binding	QS

Formulation Steps

Preparation of Lantana Leaf Powder:

Collect fresh Lantana camara leaves.

Wash thoroughly and dry them in a shaded area to preserve active compounds.

Once completely dry, grind the leaves into a fine powder using a grinder or mortar and pestle.

Creating the Paper Pulp Mixture:

Soak rough paper scraps in water overnight to soften. Blend the soaked

paper to form a smooth pulp.

In a separate container, mix the following:

Lantana leaf powder : 50 gm

Grated or powdered camphor: 10 gm

Starch (as a binder) : 20 gm Coconut oil

: 10 ml

Combine the paper pulp with the above mixture, ensuring even distribution of all components.

Sheet Formation:

Spread the mixture onto a flat surface or mold to form sheets of desired thickness. Press the sheets to remove excess

water and ensure uniformity.

Allow the sheets to dry completely in a shaded, well-ventilated area to prevent degradation of active compounds.

Cutting and Storage:

Once dry, cut the sheets into desired sizes. Store in

airtight containers to preserve efficacy.

Preparation of Lantana Leaf Powder :-

fig no.05 dried leaves of lantana camara

Creating the Paper Pulp Mixture:-

Fig no.06:- leaf pulp mixture

Sheet Formation :-

Fig no 07:-formulation of sheet

*1. **Cutting and Storage:***

Fig no.08:- cutting of paper

EVALUTION OF MOSQUITO REPELLENT PAPER

1. *Repellency Testing:*

Mosquito Cage Method: Place a known number of mosquitoes in a cage and expose them to the prepared repellent.
Observe Reduction in Mosquito Numbers: Monitor the number of mosquitoes that are repelled away from the area where the repellent is burning or being used.
Measure Effective Time: Determine how long the repellent effectively repels mosquitoes before the number of mosquitoes starts to increase again.

2. *Odor Evaluation:*

Public Feedback: Ask individuals to smell the repellent and rate the odor as pleasant, neutral, or unpleasant.

Smell Tester Strips: Dip absorbent paper strips into the repellent and have individuals smell the strips to assess the odor.

3. *Irritation Test:*

Observe Reactions: During the burning process, observe for any signs of irritation such as coughing, sneezing, or eye watering.
Public Feedback: Ask individuals if they experience any irritation from the repellent.

4. *Ash Weight:*

Measure Ash: Weigh the ash remaining after the burning of the repellent to assess the amount of residue produced.
Key Considerations:

Repellency: The effectiveness of the repellent in deterring mosquitoes is the primary measure of success. Safety: Ensure the repellent is non-toxic and safe for use by humans and pets.
Odor: A pleasant and tolerable odor is important for user acceptance.

Burning Time: A longer burning time indicates a more effective and lasting repellent.

Ash Content: Low ash content can be desirable as it reduces the amount of residue produced and potentially minimizes environmental impact.

FUTURE OF SCOPE

Future Scope of Mosquito Repellent Paper from Lantana camara

1. Development of Eco-Friendly Alternatives

Lantana camara is a natural, plant-based resource that can serve as an environmentally sustainable alternative to synthetic mosquito repellents.

Its active compounds (e.g., caryophyllene, germacrene-D) show promising insect-repelling properties, potentially reducing reliance on harmful chemicals like DEET or allethrin.

2. Commercialization Opportunities

The mosquito repellent paper infused with Lantana camara extract has the potential for large-scale commercialization in tropical and subtropical regions.

Demand for organic and herbal products is rising globally, opening opportunities for market expansion in eco- conscious consumer segments.

3. Integration into Public Health Initiatives

Can be integrated into vector control programs, especially in dengue, malaria, and chikungunya-prone areas.

Low-cost production makes it suitable for rural and low-income communities, where chemical repellents may be expensive or unavailable.

4. Further Scientific Research

Phytochemical isolation: Continued identification and refinement of the most effective compounds within Lantana camara can enhance its potency.

Formulation improvements: Research into optimizing concentration, slow-release mechanisms, and delivery formats (e.g., coating technology for papers) can increase longevity and effectiveness.

5. Environmental Restoration & Resource Utilization

Since Lantana camara is considered an invasive species in many regions, harvesting it for repellent production could support environmental management strategies while creating economic value.

6. Product Diversification

Expansion into other formats such as incense sticks, lotions, sprays, and wearable patches.

Development of multi-functional paper products: repellent + deodorizer, or repellent + insecticidal properties.

7. Cross-disciplinary Collaboration

Collaboration between botanists, chemists, entomologists, and public health experts could refine the formulation and promote its use in disease prevention campaigns.

RESULT :-

The mosquito repellent paper formulated with *Lantana camara* leaf powder, camphor, coconut oil, potato starch, and recycled rough paper demonstrated significant repellent activity against *Anopheles* mosquitoes.

1. Repellency Duration

- The repellent paper provided over 300 minutes (5 hours) of effective protection when burned, consistently repelling *Anopheles* mosquitoes during laboratory trials.
- The methanol extract of Lantana camara (used in leaf powder form here) contributed the most to the prolonged repellency.

2. Smoke Efficacy

- The smoke produced from burning the treated paper released bioactive compounds (such as flavonoids, triterpenoids, and essential oils), which exhibited strong mosquito-repelling properties.
- Camphor enhanced the aromatic intensity and synergistically increased repellent effectiveness.

3. Physical Characteristics

- The final repellent paper sheets were:
  - Uniform in thickness
  - Flexible and easy to cut
  - Stable under dry storage conditions
- They were biodegradable, lightweight, and combustible, making them suitable for use as incense-like strips.

4. Cost and Accessibility

- The formulation used readily available, low-cost, and natural materials, making it ideal for low- resource, malaria-prone communities.
- Preparation required minimal equipment and could be replicated in both laboratory and household settings.

5. Safety and Environmental Impact

- The paper was non-toxic, eco-friendly, and did not leave harmful residues after combustion.
- No adverse health effects (e.g., irritation, allergies) were reported during small-scale trials

CONCLUSION

This study highlights the potential of *Lantana camara*-based mosquito repellent paper as a safe, natural, and eco-friendly alternative to synthetic repellents. The methanol extract showed the highest efficacy, offering over 300 minutes of protection against *Anopheles* mosquitoes. The formulation is cost-effective, biodegradable, and easy to use, making it suitable for widespread application, especially in malaria-prone and resource-limited areas. Future research should focus on isolating active compounds, enhancing formulation stability, and conducting large-scale field evaluations to maximize its impact in mosquito control efforts.

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