



## **Formulation of Novel Herbal Mosquito Repellent: A New Approach in Antimalarial Management**

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**Abstract:** Today's market is flooded chemical based mosquito repellent which were proved harmful & poisonous by the most researchers. In present investigation an attempt has been made to prepare herbal based mosquito repellent several formulations like cake, jellies, coils, and liquids were prepared. Ingredients used in almost all of the formulation were herbal based & ecofriendly. Since, it has no side effect on inhalation. Same formulations were evaluated for texture, efficacy, and stability etc.

**Keywords:** Essential oil, Repellent activity, Mortality rate, Texture Analysis, Public survey.

### **1. Introduction:**

The WHO reports that malaria, parasitic disease transmitted by mosquitoes. Mosquitoes are transmitted parasites and pathogens. They spread disease like malaria, dengue, Chikungunya. Mosquito can transmit malaria to more than 700 million people annually worldwide out of which 3 million people cost a life for malaria including 2 children per min. nearly 90% of mortality attributed to it is experienced by infants and young children. Mosquito control and personal protection from mosquito bites are currently the most important measure to control this disease. Prevention of this type of disease involves protecting yourself against mosquito bites. Use of appropriate mosquito repellent is important to avoid disease. Scientists around the world are trying to develop a safe and effective vaccine for malaria. But there is still no malaria vaccine approved for human use. In countries where malaria is common, prevention also involves keeping mosquitoes away from humans. Considering seriousness of the malaria, present investigation will emphasize on the preventive approach pertaining to malaria. Various herbal sources with mosquito repellent activities have been claimed in various traditional resources like Ayurveda<sup>1-5</sup>.

Synthetic mosquito repellent used for control of vectors are causing irreversible damage to ecosystem and also chemicals are non-degradable in nature. To overcome problem, there is need for development of effective non DEET alternatives and prepare repellent by using biodegradable mosquito repellent. Natural base mosquito repellent is best alternative for DEET base synthetic chemical mosquito repellent. Natural Mosquito repellents are effective, environment friendly, biodegradable inexpensive. Natural mosquito repellents prepared from aromatic leaves or essential oils<sup>1-11</sup>.

Few of these herbal sources have been identified and developed in to cake formulation. Formulation was evaluated for appearance, efficiency and safety. The data of evaluation showed that the formulation was effective and safe.

## 2. Materials and Methods:

### 2.1. Material:

The raw material has been selected based on the traditional knowledge and experience. Traditionally we used repellent agents have been blended with some new ingredients. The most important traditional and popular ways to repelling mosquitoes was by using Neem leaves, Tulasi leaves along with camphor. It is an excellent antiviral agent when sublimated or burnt. Tulasi is the most important and most generally used medicinal plant in Indian homes and it has best antiviral and insecticidal properties.

In this addition to above mentioned traditional and Natural herbal insecticides following medicinal herbs have been selected as raw material for preparing novel herbal mosquito repellent cake. Eucalyptus oil, Lavender oil, Lemmon grass oil, Tulasi oil, Neem oil, Fennel fruit oil, Karanj oil were purchased from SK Products, U.P. India. Camphor was purchased from SD Fine Chem. Limited, Mumbai, India.

### 2.2. Methods:

Herbal resources which are reported in traditional official books of Ayurveda with insect repellent activity would be selected. Suitable solid formulation like herbal repellent cake would be developed. Essential oils in suitable natural bases would be the prime focus. Essential oils with traditional claims will be selected and blended with natural bases like pharmaceutical natural bases.

#### 2.2.1. Preparation of herbal Mosquito repellent cake.

Camphor was accurately weighed and triturated in Grinder. Then triturated camphor transferred into mortar. Measured quantity of Basil (Tulasi) oil, Neem oil, Karanj oil, Fennel oil, Lemongrass oil, Eucalyptus oil, and Lavender oil was added in the empty beaker. Then, this oil Mixed to each other with the help of stirrer. Mixed oil was added slowly to the mortar containing above camphor and Triturated with the help of pastel. Compression of the mixture was done using mild pressure on tableting machine.

#### 2.2.2. Characterization of optimization of herbal mosquito repellent cake.

##### 2.2.2.1. Mortality Rate<sup>25</sup>:

The toxicity of the oil was tested against the mosquitoes using airtight containers. Mosquitoes were released inside the containers and the filter paper impregnated with test compound was attached to the inner side of cap and thin layer of cotton was used to avoid direct contact and cap was immediately closed. The mortality of mosquitoes was observed after one hour.

##### 2.2.2.2. Repellent Activity<sup>6</sup>:

The test insects used during investigation of the action and effectiveness of the Herbal mosquito repellent cake were the common sugar ants. The insects were cautiously captured in a netted box to prevent them from escaping and starved for about 24 h under laboratory condition. Two untreated sugar cubes were carefully introduced into the box containing the captured insects. All the insects were allowed to feed on the sugar for about 48 h.

At this point, the remaining sugar cube was removed from the box, and the insects were starved for another 48 hours. After this starvation period within the confinement, a 'depleted treated' sample (that has been allowed to stand for about 48 h after treatment) was placed in the box and the number of insects hovering round it at 15 minutes intervals was recorded. After about 180 minutes, a sugar cube and herbal mosquito repellent cake was used to replace the 'depleted treated' cube in the box and the same procedure followed.

##### 2.2.2.3. Texture Analysis<sup>13</sup>:

Surface texture analysis was evaluated by using high pixel camera. (Canon EOS 40D 10.1 megapixel resolution). Several images of tablets were collected. Surface uniformity and tablet erosion was evaluated. Image highlighted the texture of tablet.

##### 2.2.2.4. Public Survey of Final Product<sup>26</sup>:

Public surveys of final product are carried on 50 volunteers to study safety and efficacy of the formulation. The formulation was distributed amongst all volunteers and feedbacks were collected. The study was conducted for 30 days. The data collected was studied statistically and represented.

**3. Results and Discussion:**

**3.1. Mortality Rate:**

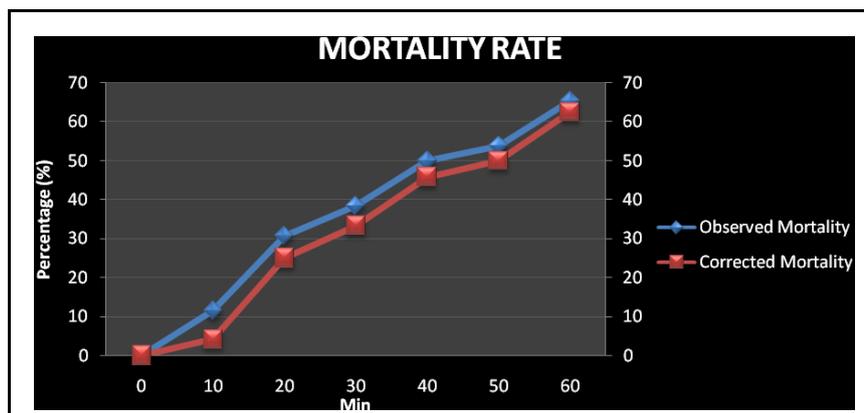
Control mortality: 7.69% (2/26)

**Table No. 3.1.- Mortality rate of mosquito repellent formulation against anopheles mosquito.**

Min.	Killed (unit)	Total (unit)	Observed Mortality (%)	Corrected Mortality (%)
0	0	26	0	0
10	3	26	11.54	4.15
20	8	26	30.76	24.99
30	10	26	38.46	33.33
40	13	26	50.00	45.83
50	14	26	53.84	49.99
60	17	26	65.38	62.49

\*1Unit = 1ants

The table shows the mortality rate. The increase mortality rate shows increase the mosquitocidal activity. Control mortality rate was found to be 7.69%. If mortality exceeds 20% in the control batch, the results of the entire test should be rejected. If mortality in the control is between 5% and 20%, the results with the treated samples should be corrected using Abbott’s formula. During test of sample, mortality rate is increases in time period of contact time of sample (mosquito repellent tablet) at 60 min it shows 62.49% mortality rate.



**Fig.No.3.1-Mortality rate of mosquito repellent formulation against anopheles mosquito.**

Justification: In prepared formulation we used excipients like Lavender oil, Lemongrass oil, Eucalyptus oil, Tulasi oil, Neem Oil, Karanj oil and camphor which shows mortality rate increased due to its mosquitocidal activity and control mortality rate was found to be 7.69%.

**3.2. Repellent Activity:**

Repellent Activity of oil was determined by using Poisson distribution.

The repellent activity was found to be approximately within 4cm area from where the prepared formulation was kept.



Fig No3.2- Repellent activity cage.

Table No.3.2.- Repellent activity of mosquito repellent formulation against sugar ants.

Time(min)	Cumulative frequency of arriving and ant (Unit)*		frequency of arriving and ant in time interval	
	Untreated sample	treated sample	F <sub>1</sub>	F <sub>2</sub>
15	3	0	3	0
30	5	0	2	0
45	7	0	2	0
60	7	0	0	0
75	9	0	2	0
90	11	0	2	0
105	15	1	4	1
120	15	1	0	0
135	19	4	4	3
150	21	4	2	0
165	24	6	3	2
180	24	7	0	1

\*1Unit = 1ants

Arrival of ants in a time span of 15 min is rare event there for we modulate by **Poisson distribution**.

Compute mean,  $\bar{X}_1 = \frac{\sum f_1(24)}{12} = 2$ ,  $\lambda_1 = \frac{1}{2} = 0.5$  and

$\bar{X}_2 = \frac{\sum f_2(7)}{12} = 0.58$ ,  $\lambda_2 = 1/0.58 = 1.72$

Result: There of significance difference between two mean arrival times.

- $\lambda_1 = 0.5$  = It means that an average an ant arrives after  $\frac{1}{2}$  units = 7.5min of time.
- $\lambda_2 = 1.72$  = It means that an average an ant arrives after 1.72 units=26 min of time.

**Conclusion**= statistically it shows that given product is very good.

### 3.3. Texture Analysis:

**Erosion method:**

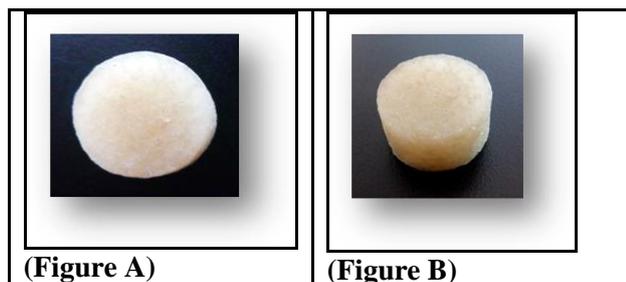


Fig.N0.3.3- Example of mosquito repellent tablet surface characterized by erosion: tablet (Figure A& B) is not more eroded.

From above image, it gives information about texture of cake. Image shows different side view of tablet and it shows there is smooth texture and also tablet edges are not eroded.

**3.4. Public Survey of Final Product:**

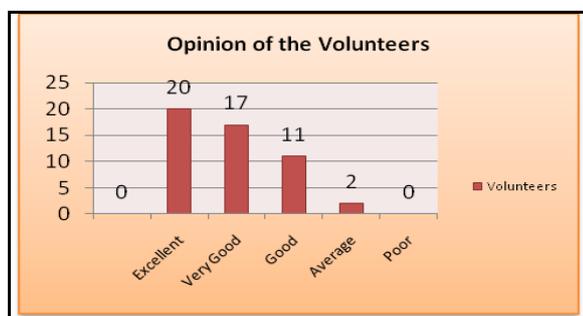
Public volunteer survey carried on 50 volunteers to study safety and efficacy of the formulation. The formulation was distributed amongst all volunteers and feedbacks were collected. The study was conducted for 30 days. The data collected was studied statistically and represented.

**Question 1: Please rate your opinion on the quality and usefulness of this product!!**

**Result:**

**Table No. 3.3- Quality and Usefulness of this product.**

Quality	No. of Volunteers	%
Excellent	20	40
Very Good	17	34
Good	11	22
Average	2	4
Poor	0	0
<b>Total</b>	<b>50</b>	



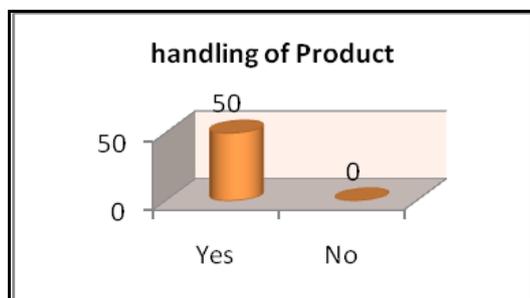
**Fig. No.3.4-Opinion of the Volunteers.**

**Conclusion=** It is positive skew curve. It means more people are in favor of using this product.

**Que. 2 Product has easy handling?**

**Table No. 3.4- Easy Handling of this product.**

	No. of Volunteers	Percent (%)
Yes	50	100
No	0	0
<b>Total</b>	<b>50</b>	



**Fig. No.3.5-Easy Handling of this product.**

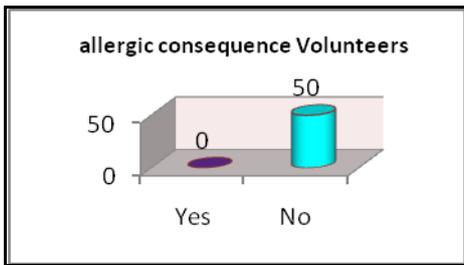
**Conclusion=** The opinion of all volunteer are favor of easy handling.

**Justification:** Handling of prepared product easy due to its size, shape, Light in weight and non-irritable nature.

**Que. 3 Any allergic consequence/s after use of this product?**

**Table No. 3.5- Any allergic consequence/s after use of this product.**

	No. of Volunteers	Percent (%)
Yes	0	0
No	50	50
Total	50	



**Fig. No.3.6-Allergic Consequence Volunteers.**

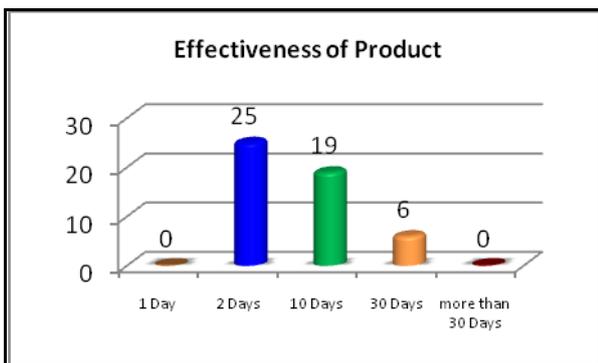
**Conclusion = No any volunteers complaints about allergic consequences.**

**Justification: allergic consequences are not observed due to its concentration of oil used and natural excipients used in prepared formulation.**

**Que.4 How long do you find the effectiveness of this product?**

**Table No. 3.6- Effectiveness of this product.**

Days	Volunteers	Percent (%)
1 Day	0	0
2 Days	25	50
10 Days	19	38
30 Days	6	12
more than 30Days	0	0
Total	50	



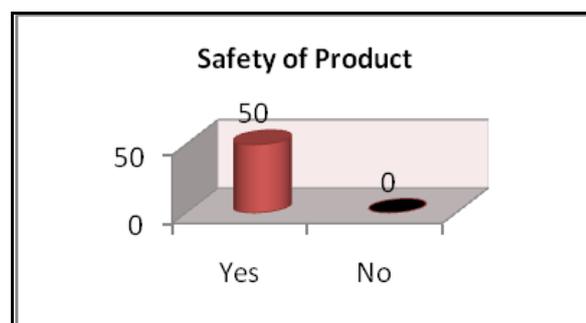
**Fig. No.3.7-Effectiveness of this product.**

**Conclusion= from the graph it shows that 25 volunteers out of 50(50%) find the effectiveness of the product up to 2 days, 19 volunteers out of 50(38%) find the effectiveness of the product up to 10 days.**

**Justification: Effectiveness of product increased due to use of fixed oil like Karanj oil, Neem oil and camphor.**

**Que. 5 Is the product safe..?****Table No. 3.7- Safety of this product.**

	No. of Volunteers	Percent (%)
Yes	50	100
No	0	0
Total	50	

**Fig. No.3.8-Safety of this product.**

**Conclusion= All Volunteers noted the product is safe.**

**Justification: Safety of product observed due to the concentration oil used and its natural nature.**

**4. Conclusion:**

In this research work, Natural base mosquito repellent was formulated successfully. Evaluation studies showed that the product was very efficient and safe to use. Mortality of mosquito repellent tablet was determined. Within 1hr, mortality rate for optimized batch was found to be 62.49%. Repellent Activity of oil was determined by using Poisson distribution. Statistically it shows that given product is very good. Public survey also taken for determine whether it is safe or not and for its effectiveness. 50% find effectiveness of product up to 2days. 38% find effectiveness of product up to 10days. From this data it may be concluded that, strong effectiveness of tablet shows up to 2-3 days. No any volunteers complaints about allergic consequences. So, it is totally safe product. Although the formulation was not able to treat the malaria but it can minimize the prevalence of the disease. The formulation was also ecological, economical and pocket friendly.

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