



Development and Study of Plant Based Mosquito Repellent Cakes in Combination with Natural Binders

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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Short Communication

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ABSTRACT

Background and Objective: Plants are perceived as a safe and trusted means of mosquito bite prevention. Many plant extracts and oils repel mosquitoes, with their effect lasting from several minutes to several hours. The present investigation is aimed to evaluate the mosquito repellent activity of *Calendula officinalis* (Marigold leaves), *Citrus madurensis* (Calamondin leaves), *Carica papaya* (Papaya leaves), *Origanum vulgare* (Oregano leaves), in combination with natural binders.

Materials and Methods: In present work we have produced an effective and purely natural mosquito repellent cakes using marigold leaves, calamondin leaves, papaya leaves, oregano leaves, and to determine if the component present on them are suitable as mosquito repellent. To recognize this new combination and in addition use of natural binder in making these mosquito cakes is innovation of method. Evaluation was carried out in a net cage (45 cm×30 cm×25 cm) containing 100 blood starved mosquitoes.

Results: Study provides an herbal repellent with long lasting protection, safe for human life, and human with no side effect. The combination Paste of leaves + charcoal + 20% cow dung was found to be more repellency against mosquitoes under study.

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Conclusion: Discovery of natural products, with potent phyto-constituents that have insecticidal properties, may help overcome problems of chemical insecticide resistance. Nature is the best combinatorial chemist to offer numerous natural products compounds from medicinal plants which can be effective as medicines, antibacterial, antifungal, insect repellent, cosmetics etc.

Keywords: Marigold leaves; calamondin leaves; papaya leaves; oregano leaves; natural binder.

1. INTRODUCTION

Repellency of plant material has been exploited for thousands of years by man, most simply by hanging bruised plants in houses, a practice that is still in wide use throughout the developing countries. Plants have also been used for centuries in the form of crude fumigants where plants were burnt to drive away nuisance mosquitoes and later as oil formulations. Plant-based repellents are still extensively used in this traditional way throughout rural communities in the tropics because for many of the poorest communities the only means of protection from mosquito bites that is available [1-3]. "Natural" smelling repellents are preferred because plants are perceived as a safe and trusted means of mosquito bite prevention. Many plant extracts and oils repel mosquitoes, with their effect lasting from several minutes to several hours. Their active ingredients tend to be highly volatile, so although they are effective repellents for short period after application, they rapidly evaporate leaving the user unprotected. The exception to this is para-menthane 3, 8 diol, which has a lower vapour pressure than volatile monoterpenes found in most plant oils and provides very high protection from a broad range of insect vectors over several hours [4].

In consideration of disadvantages of commercial mosquito coils mosquito repellents based on chemicals has a remarkable safety profile, but they are toxic against the skin and nervous system like rashes, swelling, eye irritation, corneal damage, liver damage, asthma, brain swelling in children, an anaphylactic shock, and low blood pressure. All the mosquito coils registered and sold contain synthetic pyrethroid like d-allethrin, d-transallethrin and transfluthrin as active ingredients. However even though they are effective many people dislike smell of these mosquito repellents and feels that they are harmful to health. Attempts have been made here to find out new active ingredients especially derived from natural plants to replace synthetic pyrethroid [5-8]. Methods used in preventing the spread of mosquito borne diseases include vector control, disease prevention using drugs

and vaccines and prevention of bites using insecticides, repellents and nets [9]. In present we tried to develop mosquito repellent cakes using marigold leaves, calamondin leaves, papaya leaves, oregano leaves in combination with different natural binders.

2. MATERIALS AND METHODS

2.1 Collection of leaves

Calendula officinalis (Marigold leaves), *Citrus madurensis* (Calamondin leaves), *Carica papaya* (Papaya leaves), *Origanum vulgare* (Oregano leaves), were collected from nearby botanical garden in the month of april 2021. Bundles of leaves were cut into small pieces with the help of sterile sharp scissors.

2.2 Preparation of Leaf Cakes

Cut leaf pieces were dried for two days and grounded into paste using electrical grinder by adding distilled water. The different natural binders that are coconut shell powder, potato starch, Corn starch were used to mix with above leaves paste. Final paste of above leaves with binders is caked to form cost-effective herbal mosquito repellent.

The different natural binders (100g each) were purchased commercially from local vendors. Different natural binders used were Charcoal powder, potato starch, corn starch, coconut shell powder, and cow dung. The same procedure was followed for different combinations using different natural binders for the preparation of cakes.

3. RESULT AND DISCUSSION

Controlling mosquitoes is of utmost importance in the present scenario with rising number of mosquito borne diseases [10]. Advantages of natural mosquito repellent are minimum cost, complete accessibility, enhanced tolerance, more protection and fewer side-effects. Many plant extracts have been identified as having insect-

repellent effects and there has been increasing research in the last decade proving plant based mosquito repellents.[11-15] The different combinations and ingredients used for present study are as shown in Table 1.

Table 1. Natural ingredients and natural binders in making herbal mosquito repellent

Material used	Quantity
Calamondin leaves	20 grams
Marigold leaves	30 grams
Papaya leaves	20 grams
Oregano leaves,	30 grams
Charcoal	10 grams
Natural Binder	20 grams
Water	100 ml

Fig 1. shows leaves selected for present study and Fig 2. explains preparation of mosquito repellent cakes. Details of ingredients required for herbal mosquito repellent are 20 gms of calamondin leaves, 20 gms of papaya leaves, 30 gms of marigold leaves and 30 gm of Oregano leaves, were collected and cleaned thoroughly. All leaves were cut into smaller pieces and

ground into Domestic mixer. The ground leaves were sundried for about 2 days. The dried leaves were powdered using mortar and pestle. To this mixture 20 gm of selected natural binders and 10 gm of charcoal was added with 100 ml of water. The liquid is heated at 60°C and the entire mixture was being made thick and cooled afterwards. Mosquito repellent paste has been slowly poured into the small sized Petri dish. The paste is sundried for about 36 hrs and then dried cake is removed tested for analysis.

Evaluation was carried out in a net cage (45 cm×30 cm×25 cm) containing 100 blood starved mosquitos. They were subjected to evaluation process by counting the mosquitos' death rate, landing and baiting of mosquitos. The results are summarized in Table 2. The mosquitos used in this experiment were caught using a net while biting humans between 7 pm and 10 pm. Mosquitos were starved for 24 hours and placed in the cage (45×15×30 cm). Test timing was between 7 pm and 10 pm since the mosquitos typically bite at night. The percentage repellency rate with respect to different natural binder is as shown in Fig. 2.



Fig. 1. Papaya (a), Marigold(b), Calamondin(c), Oregano(d), plant leaves used for preparation of mosquito repellent cake



Fig. 2. Preparation of mosquito repellent cakes

Table 2. Some observed parameters for herbal mosquito repellent cake with respect to time taken to burn, % repellency action and side effects

Name of the sample	Dry Weight of cake (gm)	Weight of ash{gm}	Time taken to burn (Min)	Time of observation after burning of mosquito repellent	% repellency action	Side effects
Paste of leaves + charcoal + commercial starch	10	3	12	After 10 min	75	No irritation
Paste of leaves + charcoal + coconut shell powder	12	3.5	15	After 10 min	80	No irritation
Paste of leaves + charcoal + cow dung	20	6.8	21	After 10 min	90	No irritation
Paste of leaves + charcoal + corn starch	18	7	23	After 10 min	70	No irritation
Paste of leaves + charcoal+ potato starch	13	4.8	22	After 10 min	75	No irritation

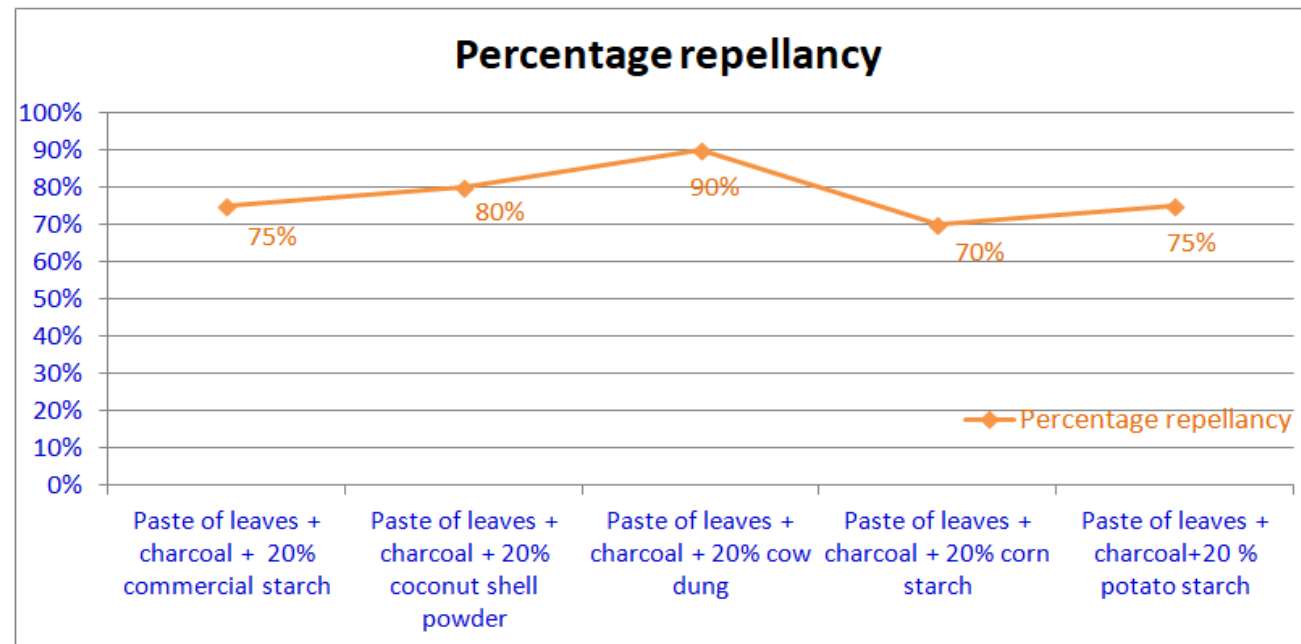


Fig. 3. The percentage repellency rate with respect to different natural binder

Table 3. Comparative efficiency of herbal mosquito repellent

Time	Type of Repellent Used	Observed Results
6–7 pm	No commercial mosquito repellent.	Numerous mosquitoes
7-8 pm	Commercial coil	100% of the mosquitoes were greatly reduced
8-9 pm	No commercial coil	No of mosquitoes increased greatly
9-10 pm	Herbal mosquito repellent cake	85% of the mosquitoes were greatly reduced

We also studied comparison between present herbal mosquito repellent cake and other commercial products available in the market and results are summarized in Table 3.

3.1 Statistical Analysis

The data were analyzed using the one-way analysis of variance and Dunnett's test. Statistical evaluations were performed using Graphpad prism and differences were considered statistically significant at $P < 0.05$.

Mosquito repellency observed with respect to different natural binders is as shown in Fig. 3 and calculated by formula, %Mosquito repellency = $((\text{Number of specimens escaped} + \text{Number of specimens dead}) \times 100) \div \text{Number of specimens exposed}$.

4. CONCLUSION

The Mosquito repellent produced from marigold leaves, colamondin leaves papaya leaves and oregano leaves with natural binders thereby reduces the product cost. These could be in form of spray, cream, liquidator, coil, candle and sticks, and could be prepared using suitable carries/solvents/diluents, to get better protection from mosquito bites. The mosquito repellent prepared with above different formulas was given for use by inhabitants of different localities. It provides an herbal repellent with long lasting protection, safe for human life, human and domestic animal skin with no side effect. This report is the preliminary work done however further extensive study with varying concentration of ingredients as well natural binders recording of mortality time and comparing with chemical based formula in the artificial mosquito coils need to be performed.

An attempt has been made to evaluate the role of medicinal plant extracts for their repellent activity and its possible formulation. The results reported in this study open the possibility for further investigations of the efficacy of repellent properties of natural products [16]. Nature is the best combinatorial chemist to offer numerous

natural products compounds from medicinal plants which can be effective as medicines, antibacterial, antifungal, insect repellent, cosmetics etc.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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