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Formulation of an herbal mosquito repellent

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Abstract: The present paper deals with formulation of a mosquito repellent product prepared using four plant materials viz, *Homalomena aromatica, Ocimum basilicum, Ageratum conyzoides* and *Litsea glutinosa* based on traditional knowledge in prevalent among the ethnic groups of Assam.

Key words: mosquito repellent; plant; traditional knowledge; ethnic groups; Assam.

Introduction

The substances which make surfaces unpleasant to mosquitoes are considered as mosquito repellents. It may be applied to skin or other surfaces which discourages mosquitoes from landing on those surfaces. These substances typically contain active ingredients that repel mosquitoes, as well as secondary ingredients which aid in delivery of cosmetic appeal. These repellents are available in many forms - creams to lotions to oils, but are most often sold as aerosol products. There are also repellents available based on sound productions, particularly ultrasound (inaudible high frequency sounds) (Sah *et al*., 2010). Traditionally, various types of substances have been used to repel mosquitoes. These include smoke, plant extracts, oils, tars, and muds. Most of the repellents work by interfering with the mosquito's homing system. This homing system, located on the antennae of the organism possesses a number of chemical receptors. Carbon dioxide, excretory products and lactic acid present in sweat in warm-blooded animals act as an attractive substance for female mosquitoes. The chemical receptors are activated by lactic acid, which naturally evaporates from the skin of warm-blooded animals. However, when a repellent ingredient containing the active repellent such as DEET (n-n-diethylmetatoluamide) is applied to the skin, it also evaporates. The repellents block the lactic acid receptors thus destroying upwind flight and as a result the mosquitoes lose its contact with the host (Elissa *et al.,* 2004; Sah *et al.,* 2010). This essentially "hides" the protected person from the mosquito.

North East India, having tropical climate is infested with several diseases such as malaria, dengue, etc. caused by mosquitoes. The mosquitoes act as a vector for the transmission of these deadly diseases. The need to protect ourselves from their bites seems more important. Much of the literature about mosquitoes provided by government agencies recommends regular use of mosquito repellents most often containing DEET as the major chemical component. Many health problems such as headache, breathing difficulties, heart attack, etc. are the result of long term use of DEET either directly or indirectly. Now-a-days, people are looking for mosquito repellents which are safer and preferably herbal based. There occur several plants around us containing certain essential oils, often found to be affective insect repellents. Many of these plants are herbs or shrubs often considered as weeds. Unfortunately, their use has been known only to some ethnic groups. The use of herbs as mosquito or other insect repellents has been incorporated in many cultural rituals of these ethnic groups from time immemorial. Assam is bestowed with diversity of ethnic groups as well biodiversity with associated traditional knowledge. Taking traditional knowledge as clue certain plants have been selected processed and produced to prepare a mosquito repellent. The aim of the study was to an eco-friendly, economic, non-hazardous, herbal mosquito repelling product using locally available plant resources.

Materials and Methods

Selection of raw materials: The active ingredient in a mosquito repellent is primarily responsible for its usefulness. The criteria considered in the present study for evaluation of plant materials as mosquito repellent includes : (i) discourage insect attack on the treated area for many hours and on different types of surfaces, (ii) work under a variety of different environmental conditions, (iii) non toxic or cause irritation when applied to human or animal skin, (iv) cosmetically acceptable, having a pleasant odour, taste, and feel and (v) relatively low cost and be effective against other common types of insects, such as flies. The four plant materials selected for the present study on the basis of their use as mosquito repellent among different ethnic groups of Assam viz., the Karbis, Dimasas, Bodos and Mishing for generations based on their experience and traditional knowledge **(Table1)**. The information was collected firsthand by undertaking field work among these ethnic groups.

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Table 1: List of plants used with their respective vern names and parts used.

S. No.	Name of the plant species	Vern name (Assamese)	Parts used
1	*Homalomena aromatica* (Roxb.) Schott	Gonkochu	Dry rhizome
2	*Ocimum basilicum* L.	Bon-tulsi	Whole plant
3	*Ageratum conyzoides* L.	Gendhali bon	Whole plant
4	*Litsea glutinosa* (Lour.) C.B. Robins	Baghnol	Bark

Preparation of the cakes: After clearing the plant samples, they were weighted (fresh weight) and allowed to shade dry for a few days. They were again weighted (dry weight) after the plant materials are completely dried up. The dried materials were grinded in a metal grinder. Finally, the powdered samples were mixed in different ratio to prepare cakes of 10 gm each and tested for effectiveness.

Preparation of natural binding material: The powder of bark of *Litsea glutinosa* is used as natural glue as it possesses adhesive property. It swells in water and form a gel. Glues were prepared using three different solvents viz., cold water, warm water and ethyl alcohol and tested for their maximum stickiness. 1.6 g of the powdered bark of *Litsea glutinosa* is mixed to 10ml of each solvent and left for overnight.

Preparation of cakes with the natural binding material: The effectiveness of the glue is tested in accordance to the stickiness of the glue. The stickiness is found to be highest in the sample prepared by using warm water as the solvent. The degree of stickiness varies in the following order: warm water > cold water > ethyl alcohol. Finally, the dried grinded plants materials were mixed with the glue in different composition as such to prepare cakes of 10 gm each (Table 2).

Table 2: Table showing individual weight of plant components in different sample combinations.

S.No.	Sample Codes with respective composition	*Homalomena aromatic* (Rhizome)	*Ocimum basilicum* (whole plant)	*Ageratum conyzoides* (whole plant)	*Litsea glutinosa* (Bark)
1	A1 (1:1:1:1)	2.5 g	2.5 g	2.5 g	2.5 g
2	B1 (2:1:1:1)	4 g	2 g	2 g	2 g
3	C1 (4:1:1:1)	5.7 g	1.4 g	1.4 g	1.4 g
4	A2 (1:1:1:1)	2.5 g	2.5 g	2.5 g	2.5 g
5	B2 (1:2:1:1)	2 g	4 g	2 g	2 g
6	C2 (1:4:1:1)	1.4 g	5.7 g	1.4 g	1.4 g
7	A3 (2:2:1:1)	3.3 g	3.3 g	1.6 g	1.6 g
8	B3 (2:1:2:1)	3.3 g	1.6 g	3.3 g	1.6 g
9	C3 (1:2:2:1)	1.6 g	3.3 g	3.3 g	1.6 g

Table 3: Table showing effectiveness of each sample prepared in different combinations with respect to the combustion time and reoccurrence of mosquitoes in the study site.

S. No	Trial Sample composition	Sample Codes	Time of combustion	Period of Effectiveness			
				1 hour	2 hours	3 hours	4hours
1	1:1:1:1	A1	12 min	+	+	-	-
2	2:1:1:1	B1	14 min	+	+	+	-
3	4:1:1:1	C1	17 min	+	+	+	+
4	1:1:1:1	A2	10 min	+	+	-	-
5	1:2:1:1	B2	15 min	+	+	-	-
6	1:4:1:1	C2	18 min	+	+	+	-
7	2:2:1:1	A3	15 min	+	+	+	+
8	2:1:2:1	B3	12 min	+	+	+	-
9	1:2:2:1	C3	10 min	+	+	-	-

Evaluation of mosquito repellent activity: For investigating mosquito repellent activity the prepared cakes were checked for its flammability, burning efficiency with respect to burning time and eventually its effective repellent activity. Flammability test of these cakes were conducted to check its consistent combustibility. Further, the time taken to burn the cake, smoke produced and its causal effect such as irritation, coughing, tears were observed and recorded. The cakes were burnt in selected mosquito prone areas in the evening and night period such as bushes and shrubs of department premises, laboratory corners, and cafeteria.

Results

Flammability test and burning time: To observe the flammability of the cakes, the cakes were burnt. The time taken to burn the cake completely and the total time of repellence were recorded (Table 3). For a good and consistently burning mosquito repellent cake, it is necessary that the cake should be burnt slowly and completely producing low smoke and capable to repel mosquitoes to a longer time.

The sample **C1** of composition ratio **4:1:1:1** records for the optimal time of combustion being able to repel mosquitoes from the selected study sites for a time period of 4hours from its time of combustion.

Mosquito repellence test: Mosquito repellence test was done by simply selecting the mosquito prone areas in the evening and night period such as laboratory corners, bushes and shrubs in and around Department premises and cafeteria. The public remarks were noted down after allowing them to burn the cakes and checking if the mosquitoes are present or escaping away from the sites of burning cakes (Table 4).

Table 4: Mosquito repellence test in different areas of Department of Botany.

S. No.	Areas	Reports given by people	Remarks
1	Laboratory corners	No irritation, mosquitoes removed from room	Mosquitoes are repelled
2	Department premises	Smoke does not cause irritation, mosquitoes escaped	Mosquitoes are repelled
3	Cafeteria of G.U. Campus	No irritation, mosquitoes escaped	Mosquitoes are repelled

From all the trials carried out so far, the sample bearing composition ratio 4:1:1:1 proves to be the best combination for preparation of cake showing no irritation and good burning time and maximum mosquito repelling time.

Discussion

The use of synthetic chemicals to control insects leads to several environment and human health hazards. An alternatives solution is to use natural products that possess good efficacy and environmental friendly. Among those chemicals, essential oils from plants belonging to several species have been extensively tested to assess their repellent properties as a valuable natural resource. From the present study, it can be concluded that the cakes prepared from *Homalomena aromatica, Ocimum basilicum* and *Ageratum conyzoides* powder together with the powdered bark of *Litsea glutinosa* as a binder is able to repel mosquitoes effectively and is therefore can be recommended as a suitable herbal mosquito repellent. However, further extensive study by collecting specific number of mosquitoes in a glass chamber covered with cloth sieve and exposing them to the smoke generated by the herbal product with the varying concentrations and recording of mortality time and comparing with chemical based formula in the artificial mosquito coils need to be performed.

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