

REPELLENCY OF *LANTANA CAMARA* (VERBENACEAE) FLOWERS AGAINST *Aedes* MOSQUITOES

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ABSTRACT. The repellent effect of *Lantana camara* flowers was evaluated against *Aedes* mosquitoes. *Lantana* flower extract in coconut oil provided 94.5% protection from *Aedes albopictus* and *Ae. aegypti*. The mean protection time was 1.9 h. One application of *Lantana* flower extract can provide more than 50% protection up to 4 h against the possible bites of *Aedes* mosquitoes. No adverse effects to the human volunteers were observed through 3 months after the application.

INTRODUCTION

The repellent properties of plants to mosquitoes and other pest insects were well known before the advent of synthetic chemicals (Curtis et al. 1989). A review on the uses of botanical derivatives against mosquitoes has been reported recently (Sukumar et al. 1991). Incense sticks, mats, and electronic assemblies have become quite popular in recent years. However, most vaporizing assemblies incorporate natural or synthetic pyrethroids (Vartak and Sharma 1993). Prolonged use of insecticide-impregnated coils and mats may be harmful to human health (Liu et al. 1987). Essential oils and terpenoids also show repellency to adult mosquitoes (Curtis et al. 1989). Sharma et al. (1993) have reported the effectiveness of neem oil as an alternative and safe method of protection from mosquitoes.

Lantana camara Linn. (family Verbenaceae) is a woody weed plant with a number of flower colors, viz., red, white, yellow, pink, and violet. *Lantana camara* is a very hardy shrub growing luxuriantly at elevations up to 2,000 m in tropical, subtropical, and temperate parts of the world. The plant is spread widely over Himachal Pradesh, Jammu region, hilly areas of Uttar Pradesh, and the northeastern states of India where it has developed into a serious pest. A review on *Lantana camara* was published by Sharma et al. (1988). In this paper we report the repellent effect of *Lantana camara* (red variety) flowers extracted in coconut oil against *Aedes* mosquitoes.

MATERIALS AND METHODS

The study was conducted within the plant area of Bharat Heavy Electricals Limited (BHEL) Hardwar because of a predominance of *Aedes* mosquitoes due to their extensive breeding in

iron scrap, discarded drums, and tires (Dua et al. 1993).

Twenty-five grams of *Lantana camara* (red variety) flowers were crushed in a mortar with 25 ml distilled water and made into a thick slurry. Fifty milliliters of methanol (analytical reagent grade) was added, followed by 50 ml coconut oil; this was then mixed for 4 h on an orbital mixer. The upper layer was then separated and kept in an evaporator at 60°C for 1 h to remove the methanol. This extract (approximately 1.8% w/v) is referred to as *Lantana* flower extract in this paper and its repellency against *Aedes* mosquitoes was studied.

The mosquito repellency of *Lantana* flower extract was assessed on the basis of the protection time (h) against *Aedes albopictus* (Skuse) mosquito bites. Repellency was tested against 3-6-day-old, blood-starved, sucrose-fed (0.5 M solution), *Ae. albopictus* removed from a well-established laboratory colony. In the experimental test with repellents, only the upper surface of the arm was used; the lower surface was covered with aluminium foil. An untreated arm first was exposed for 5 min in a cage containing 100 mosquitoes and the rate of mosquitoes biting was recorded. Ten to 15 mosquito bites per 5 min were recorded on an untreated arm. Then 2.5 ml of *Lantana* flower extract was applied on the arm, it was exposed in the mosquito cage, and the number of mosquito bites in 5 min was counted. In the event of no bites in the initial 5 min, the test arm was exposed after every 30 min for 5 min until a confirmed bite was received. The same test was repeated for 5 human volunteers.

The efficacy of *Lantana* flower extract was measured by determining the number of biting mosquitoes at different time intervals, viz., 30 min, and 1, 2, 3, 4, and 5 h after an application of 5 ml *Lantana* flower extract on human volunteers as compared to coconut-treated volunteers (control, $n = 5$) under field conditions.

Twenty-four biting collections used 4 human baits (all male). Each collection contained 2 *Lantana* flower extract-treated (experimental)

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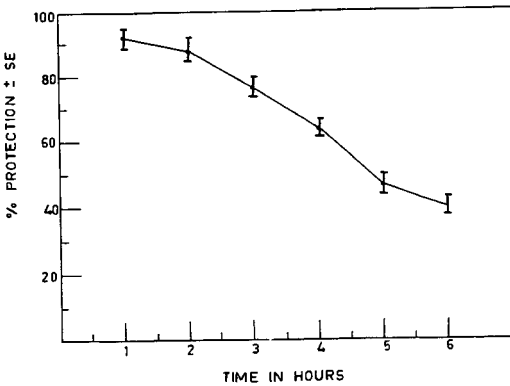


Fig. 1. Field trials on the repellent action of *Lantana* flower extract against *Aedes* mosquitoes with time.

and 2 coconut oil-treated (control) humans and was conducted from September to November 1993 between 1500 and 1730 h. Only those baits were selected that attracted mosquitoes. Five milliliters of *Lantana* flower extract was applied uniformly on each experimental human bait over the arms, legs, and other exposed parts of the body. The control human bait was treated similarly with coconut oil. Mosquitoes were collected on the bait with the help of a mouth aspirator and a flashlight. Baits were rotated between experimental and control groups. Similarly, insect collectors were also interchanged between the 2 groups to avoid sampling errors. Mosquitoes collected from the field were identified to species and tabulated. Percentage protection was calculated by the following formula:

$$\begin{aligned} & \% \text{ protection} \\ &= \frac{\text{No. collected in control} - \text{no. collected in treated (exp.)}}{\text{No. collected in control}} \times 100. \end{aligned}$$

The significance of the difference between the number of mosquitoes caught was evaluated by Student's *t*-test.

RESULTS AND DISCUSSION

The mean protection time after the application of *Lantana* flower extract on human volunteers (*n* = 5) against *Ae. albopictus* was 1.9 ± 0.4 h (range 1.5–2.5 h), which is low compared to the protection time reported for the synthetic compound diethyl toluamide (deet) (Curtis et al. 1989). The field trials on the efficacy of *Lantana* flower extract on application to human volunteers with time are shown in Fig. 1. It is clear that the use of *Lantana* flower extract gave more

Table 1. Repellent effect (1 h after application) of *Lantana camara* flower extract in coconut oil against *Aedes* species.¹

	Total no. mosquitoes	Mean ± SD mosquitoes per human bait	% reduction
Control	1,132	47.6 ± 31.9	
Experimental	62	2.8 ± 2.7	94.5

¹ Based on *n* = 24. Student's *t*-test, *t* = 6.60, *P* < 0.001.

than 50% biting protection for up to 4 h from the bites of *Ae. albopictus*.

The repellency of *Lantana* flower extract against *Aedes* mosquitoes under field conditions is given in Table 1. The extract gave 94.5% protection against *Aedes* mosquitoes for 1 h following application to human volunteers. There is a statistically significant (*t* = 6.60, *P* < 0.001) difference between the treated and untreated control groups. Out of 1,132 *Aedes* collected from the controls, 992 (87%) were *Ae. albopictus* and 140 (13%) were *Ae. aegypti* (Linn.), whereas in the treated group, 49 of 62 (79%) *Aedes* were *Ae. albopictus* and 13 (21%) were *Ae. aegypti*. A statistical analysis of the effectiveness of *Lantana* flower extract on repelling *Ae. albopictus* and *Ae. aegypti* showed no significant difference, which implies that the *Lantana* flower extract has a similar repellent action upon both species.

Twenty-four biting collections were again carried out from August to November 1994 to confirm the reproducibility of the 1993 field trial. There were 1,437 *Aedes* mosquitoes collected from the controls (coconut treated), whereas 171 *Aedes* were collected from the experimental (*Lantana* flower-treated) group, which showed 89% biting protection 1 h after the application.

The need for the investigation of phytochemicals as repellents against mosquitoes has been stated by Novak (1985) in his review of non-chemical approaches to mosquito control in Czechoslovakia. Phytochemicals offer not only effective mosquito control agents but also are biorational alternatives to synthetic pesticides.

The present study clearly showed that the application of *Lantana* flower extract gave 94% biting protection against *Aedes* mosquitoes, which is greater than the percentage protection reported for neem oil against *Aedes* under similar field conditions (Sharma et al. 1995). Moreover, one application may give more than 50% protection up to 4 h. However, the protection time for *Lantana* flower extract was found to be shorter than that of the synthetic compound deet (Curtis et al. 1989).

No adverse effects on the skin or other parts

of the body of the human volunteers were observed during the study period and through 3 months after the application. However, a light orange stain, which can be washed off with any soap solution, was found on the skin after the application.

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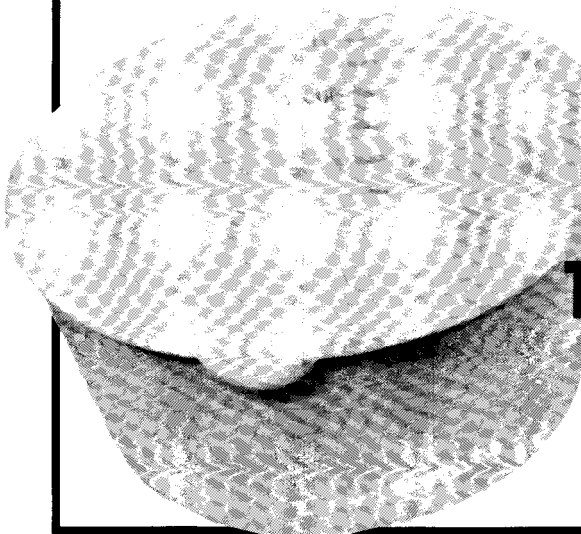
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