

## Repellent action of neem cream against *An. culicifacies* and *Cx. quinquefasciatus*

Various methods for protection from mosquito bites such as the oils, coils, mats, creams, etc. are used worldwide<sup>1-3</sup>. Effectiveness of these methods lasts for 5–7 h with 60–80% protection<sup>4,5</sup>. Synthetic pyrethroids such as allethrin, bioallethrin and related chemicals used in these repellents are generally safe, but their prolonged use may be harmful<sup>6</sup>. In search of alternative and safe methods of protection from mosquitoes, neem (*Azadirachta indica*) products are emerging as good mosquito repellents<sup>7-9</sup>. All these products have shown 90 to 100% protection against malaria vectors and about 70% against *Culex quinquefasciatus*. We have prepared a vanishing-based perfumed neem cream as a mosquito repellent. Results of its evaluation against *Anopheles culicifacies* and *Cx. quinquefasciatus* are presented in the paper.

A study site was selected on the banks of a canal in Ghaziabad district near Delhi. The most dominant mosquito species in the village was *An. culicifacies* and *Cx. quinquefasciatus*. The neem cream ingredients comprise vanishing base, perfume and 5% neem oil, mixed thoroughly in an appropriate proportion to prepare neem oil cream. Base cream without neem oil was also prepared to serve as control. Four to five g of neem cream was applied on the exposed body parts of the human bait, i.e. hands, legs and face. Field evaluation of neem cream was carried out in May–June 1994 and August–September 1995. Landing mosquitoes were collected from each bait from dusk to dawn with the help of suction tube and torchlight. Precaution was taken to prevent probing by the landing mosquitoes to avoid any risk of acquiring infection. To minimize bias, baits and sites were rotated based on orthogonal Greco-Latin square. By this method each insect-collector got an opportunity to collect mosquitoes from all baits in each dwelling. Effective protection, i.e. time period between the application of the repellent and the first bite of the mosquito on the treated parts of the bait was recorded. Per cent protection was calculated by the following formula:

$$\% \text{Protection} = \frac{(\text{MC} - \text{ME})}{\text{MC}} \times 100,$$

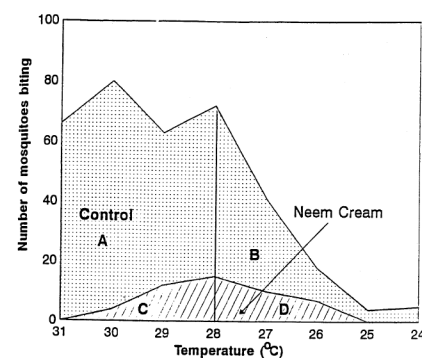
where MC is the number of mosquitoes collected in control bait and ME is the number of mosquitoes collected in experimental bait.

Hourly temperature of experimental and control rooms was also recorded simultaneously to study the impact of this parameter on biting activity of the mosquitoes. Besides the field evaluation of the neem cream, assessment of community acceptance was also done.

In May–June 1994, the results of neem cream were compared with those of base cream (Table 1). During this period only 10 whole-night collections were made. A total of 143 *Cx. quinquefasciatus* mosquitoes were collected from the bait treated with 5% neem cream compared to 567 mosquitoes in control (base cream). The perfumed neem cream provided 75% protection against *Culex* biting. Neem cream with base cream shows significant difference ( $P = 0.0002$ ). It is also noteworthy to mention that during this season the indoor density of anopheline mosquitoes was very low. Therefore not a single specimen was collected on human baits. The effective protection period recorded for the neem cream was about 2 h.

Similar results were reported by other investigators in the country against *Aedes*, *Culex* and *Anopheles* mosquitoes<sup>10,11</sup>.

Table 2 provides the results of neem cream as mosquito repellent for 12 whole-night collections carried out in August–September 1995. A total of 61 specimens of *Cx. quinquefasciatus* were collected from the human baits treated with 5% perfumed neem cream. From baits without any repellent (control) 336



**Figure 1.** A + B denotes the area under control curve and C + D under neem cream curve. The area under curves A and C depicts that the biting was maximum at higher temperature. The maximum biting in control was found at 30°C, while in neem cream it was at 28°C, which shows string-repellent action of neem cream and shifting of peak biting activity at lower temperature.

**Table 1.** Repellent action of 5% neem cream against *Cx. quinquefasciatus* mosquitoes in a village in Ghaziabad during May–June 1994\*

Time (h)	No. of <i>Cx. quinquefasciatus</i> mosquitos collected on human bait	
	5% perfumed cream	Base cream
1900–2000	0	6
2000–2100	0	30
2100–2200	10	47
2200–2300	10	44
2300–2400	22	75
2400–0100	25	89
0100–0200	19	83
0200–0300	30	84
0300–0400	15	68
0400–0500	11	41
Total 10 h	142	567
% Protection compared to base cream	75	

\*Result of 10 whole-night collections; Neem cream vs base cream,  $P = 0.0002$  – Significant.

**Table 2.** Repellent action of 5% neem cream against mosquitoes in a village of Ghaziabad during August–September 1995\*

Time (h)	No. of mosquitoes collected on human bait					
	5% perfumed neem cream		Base cream**		Control***	
	Cx.	An.	Cx.	An.	Cx.	An.
1900–2000	0	0	13	0	26	0
2000–2100	0	0	12	0	49	0
2100–2200	0	0	5	2	40	1
2200–2300	1	0	9	1	39	1
2300–2400	7	0	14	1	36	1
2400–0100	8	0	12	1	34	1
0100–0200	17	0	6	1	38	0
0200–0300	14	0	9		32	2
0300–0400	12	0	7	1	26	0
0400–0500	2	0	3	1	16	0
Total (10 h)	61	0	90	8	336	6
% Protection compared to control	82	100	73	–33	–	–

\*Results of 12 whole-night collections; \*\*Results of 5 whole-night collections; \*\*\*Control without any repellent; Cx. = *Cx. quinquefasciatus*; An. = *An. culicifacies*; Neem cream vs base cream  $P = 0.008$  – Significant; neem cream vs control,  $P = 0.002$  – Significant.

mosquitoes were collected. No specimen of *An. culicifacies* was collected on the baits treated with neem cream, i.e. 100% protection was observed compared to control, whereas against *Cx. quinquefasciatus* 82% protection was recorded. Base cream also provided 73% protection against *Cx. quinquefasciatus* bites, but there was no protection against the anophelines as 8 specimens of *An. culicifacies* were collected in 5 whole-night collections. The statistical analysis ( $t$ -test) revealed that there was a significant difference in protection by neem cream compared to base cream ( $P = 0.0008$ , 5-night collections) and control ( $P = 0.0002$ ). It is noteworthy to mention that during this period also the neem cream gave complete protection for 3 h.

In twelve-night collections during August–September 1995, maximum temperature at dusk was 31°C and minimum at dawn was 24°C. The mosquitoes collected between  $t^{\circ}\text{C}$  and ( $t-1$ )°C were recorded as mosquitoes at

$t^{\circ}\text{C}$ . Total range, i.e. from 31 to 24°C was divided in two equal halves (31–27.5) and (27.5–24)°C as shown in Figure 1. Discrete analysis at various temperatures revealed that peak biting in control area was at 30°C whereas in neem cream area it was at 28°C, and biting at these two temperatures was found statistically non-significant ( $P = 0.01$ ). It shows that the neem cream had a strong repellent action and forced the mosquitoes to bite late, at lower temperature, against their preference to have high biting activity at higher temperature.

Results of the assessment of community acceptance of the neem cream revealed that out of 102 individuals, 93 (92%) showed preference for the use of neem cream as mosquito-repellent. Reasons stated for this preference were (i) easy application of neem cream, (ii) pleasant odour, (iii) mosquitoes were repelled effectively up to 4 h after application, (iv) safe, no adverse reaction, and (v) better than any other repellent.

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B. N. NAGPAL  
ARUNA SRIVASTAVA\*  
NEENA VALECHA  
V. P. SHARMA

*Malaria Research Centre,  
20, Madhuban,  
Delhi 110 092, India*

\*For correspondence.  
(e-mail: arunas@ndf.vsnl.net.in)