influence than the feeding time in the reproduction of spotted munia.

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TOXIC EFFECT OF MANGROVE PLANT EXTRACTS ON MOSQUITO LARVAE *ANOPHELES STEPHENSI* L.

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PLANT extracts are known to show potent toxicity to mosquito larvae[1-3]. However, no report on the toxicity of mangrove plants to mosquitoes has appeared. This paper deals with the larvicidal action of 17 extracts of mangrove plants against the mosquito, *Anopheles stephensi* L. (Diptera: Culicidae), the malarial vector.

Plant materials were collected from the Pitchavaram mangroves (Lat. 11°26'N; Long. 79°48'E), shade-dried and powdered. The materials were extracted in a soxhlet apparatus using acetone[2,4]. Stock solution of 1% (w/v) was prepared with acetone, from which different test concentrations ranging from 10 to 100 ppm were prepared in unchlorinated and filtered tapwater followed by vigorous stirring[5]. Tween-80 was used as an emulsifier[4]. Twenty five larvae of early fourth instar were released in 250 ml of test solution and four replicates were run at a time. Separate controls using acetone and tween-80 were also run. Mortality counts were made at 24 h of treatment[5].

As is evident from the data (table 1), the stilt root extract of *Rhizophora apiculata* was highly effective against the larvae of *A. stephensi* with LC_{50} of 17 ppm. Leaf extracts of *Avicennia marina* and *Suaeda maritima* were also effective against the test organism with LC_{50} of 52 and 80 ppm respectively. Leaf extracts of *Suaeda monoica*, *Excoecaria agallocha*, *Aegiceras corniculatum* and the leaf and stilt root extracts of *Rhizophora mucronata* were effective only above 100 ppm (table 1). In all the other plants studied i.e., the leaf extracts of *Acanthus ilicifolius*, *Avicennia officinalis*, *Bruguiera cylindrica*, *Ceriops decandra*, *Lumnitzera racemosa*, *R. apiculata*, *Salicornia brachiata* and the root extracts of *A. ilicifolius* and *E. agallocha* no mortality was observed up to 100 ppm.

Table 1 *Toxicity of mangrove plant extracts towards fourth instar larvae of Anopheles stephensi* L.

Plant extract		Larval mortality* (%) after 24 h treatment with ppm of extract						
		10	20	40	60	80	100	LC_{50} (ppm)**
R. apiculata Blume.	(stilt root)	30	54	74	100	100	100	17
A. marina (Forsk.) Vierh.	(leaves)	—	14	38	56	77	94	52
S. maritima (L.) Dumort.	(leaves)	17	25	32	48	52	68	80
S. monoica Forsk.	(leaves)	—	4	8	17	26	48	—
E. agallocha Linn.	(leaves)	—	—	—	8	16	42	—
A. corniculatum (L.) Blanco	(leaves)	—	—	—	12	30	41	—
R. mucronata Lamk.	(stilt root)	—	—	10	16	23	38	—
R. mucronata Lamk.	(leaves)	—	—	11	14	20	32	—

*Average value of 4 replicates. '—' indicates no mortality.
**$LC_{50} > 100$ ppm.

Many workers haye studied only the larvicidal action of terrestrial plant extracts against the larvae of *A. stephensi*[1-3]. Among the samples studied the acetone extract of *Ipomea carnea*[2] and the petroleum ether extract of the *Calotropsis*[1] species were found effective with LC_{50} of 180 and 21.7 ppm respectively. As effective concentrations less than 50 ppm are known to be economical for field use in mosquito larval control[1], the stilt root extract of *R. apiculata* which is effective at a lowest concentration of 17 ppm, can be attempted for mosquito control practices. The isolation, purification and structural elucidation of the larvicidal principles are in progress.

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A LARGE SCALE TRIAL WITH PENFLURON TO SUPPRESS THE POPULATION OF *ANOPHELES STEPHENSI* (LISTON)

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PENFLURON and other chitin inhibitor compounds are superior to other insecticides[1-4]. The residual toxicity of these compounds to other non-target animals is negligible[5]. Laboratory studies have shown that chitin inhibitors are particularly effective in suppressing species of mosquitoes[1-4]. However, these findings have not yet been tested on a large scale, in order to recommend these compounds for field applications for suppressing mosquito vector populations. The present paper deals with the field evaluation of Penfluron, a potent chitin inhibitor, for suppression of larval and pupal populations of the malaria vector, *Anopheles stephensi*.

Water collected in cement receptacles of 500 litres capacity containing *A. stephensi* population was treated with different concentrations of Penfluron. The volume of water was estimated by measuring the surface area and depth of water. The density of larvae and pupae was estimated by the dipper sampling method, using a dipper. An average of 5 dips was considered. The density was estimated before spraying and after 24 h of application in order to determine the effect of the compound.

For the application, a 1% (w/v) stock solution was prepared by dissolving the compound in acetone. Tween-80 was used as an emulsifier. Further, different ppm concentrations were prepared by diluting the stock solution with water. The required volume of the test formulation was sprayed on the surface of water using a hand sprayer at concentrations ranging from 0.1 ppm to 0.001 ppm (table 1).

Table 1 shows that Penfluron is highly effective in suppressing the population of *A. stephensi*. Of the three doses evaluated (0.1, 0.01 and 0.001 ppm) 0.1 ppm is most effective causing a fall of 84% in adult emergence upon treating fourth instar larvae and a fall of 100% upon treating second instar larvae within 6 and 10 days after treatment respectively.

At all the doses tested, most of the deaths occurred during moulting as reported earlier[1].

The compound is not effective against pupae of *A. stephensi* at the concentrations of 0.001, 0.01 and 0.1 ppm, as also reported with Diflubenzuron and Furyltriazine.

The second instar larvae are most susceptible and a complete suppression of population is observed upon treatment at this stage with 0.1 ppm of the inhibitor. It is thus recommended that the 2nd instar is the most appropriate stage for treatments, ensuring no adult emergence.

Based on these findings, a dose of 0.1 ppm of Penfluron is recommended for field applications to suppress effectively the breeding of *A. stephensi*. Penfluron thus warrants inclusion in field application programmes for the control of the malaria vector, *A. stephensi*.

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