INSECTICIDE IMPREGNATED COTTON FABRICS OF DIFFERENT HYDROPHOBICITY AGAINST *AEDES AEGYPTI* (DIPTERA:CULICIDAE)

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Abstract. Residual efficacy of synthetic pyrethroids, *viz*, permethrin, deltamethrin, lambdacyhalothrin and an insect repellent DEPA in cotton fabrics of different hydrophobicity was tested against *Aedes aegypti*. Amino silicone was used for enhancing the hydrophobicity of the fabrics. The results showed that there was an increasing trend in repellency/feeding deterrency with the increase in hydrophobicity up to 17.5 weeks at an optimum level of 30g/l. The adulticidal effect lasted for 1 to 4 weeks and this lower residual activity was attributed to the repellency of the treated fabrics. The results indicated that the residual efficacy of cotton fabrics could be enhanced by treating with an hydrophobic agent that increases the availability of the insecticide on the surface.

INTRODUCTION

The use of bednets and curtains impregnated with synthetic pyrethroids has been considered as one of the means of reducing man-vector contact (Darriet *et al*, 1984; Lines *et al*, 1987; Majori *et al*, 1987; *Curtis et al*, 1990, 1992; Curtis, 1992). Bednets of cotton or nylon impregnated with permethrin have been widely used in the study (Rozendaal, 1989; Rozendaal and Curtis, 1989; Magesa *et al*, 1991) and achieved reduction in malaria in some situations (Graves *et al*, 1987; Alonso *et al*, 1991; Lyimo *et al*, 1991; Kere *et al*, 1995). However, trials carried out with insecticide impregnated mosquito nets all over the world showed that the complete interruption of disease transmission could not be achieved, partly due to outdoor transmission (*ie* some malaria vectors are exophilic) and improper use of nets (Jambulingam *et al*, 1989; Das *et al*, 1993). Further, transmission might occur before one goes to bed. Moreover, people in tropical countries generally do not prefer to sleep under bednets because of insufficient circulation of air (Neeru *et al*, 1994). Therefore other methods of protection from mosquitos were explored. Permethrin when impregnated into military uniforms gave > 90% protection (Schreck *et al*, 1984; Lillie *et al*, 1988). Pyrethroids when used for impregnating jackets, hoods and anklets have been found to be effective against mosquitos, black flies and ticks (Lindsey and McAndless, 1978; Schreck *et al*, 1980). Tents impregnated with permethrin provided 96% protection for > 9 months against biting of *Aedes aegypti* (Schreck, 1991). However, field trials conducted with permethrin treated tents showed 84-94% protection from *Aedes* spp for only 42 days (Heal *et al*, 1995). The use of insecticide impregnated screens and/or curtains as a cheaper and more effective vector control method has received much attention in recent years (Curtis and Lines, 1985; Kurihara *et al*, 1985; Majori *et al*, 1987; Procacci *et al*, 1991; Poopathi and Raghunatha Rao, 1995). The materials used for making mosquito nets are mostly nylon or other synthetic materials whereas curtains and screens are mostly made of cotton fabric. Gupta *et al* (1989, 1990) reported sustained effect of cloth fibers treated with permethrin for several weeks even while subjected to accelerated weathering. However, a recent study (VCRC, unpublished data) showed that the residual activity of the cotton clothing impregnated with permethrin at 0.5 g(ai)/m^2 and deltamethrin at 0.025 g(ai)/m^2 lasted for less than a week due to non-availability of the insecticide on the surface as the insecticide got absorbed in the cotton. Therefore, an attempt was made to increase the availability of the insecticide on the surface by increasing the hydrophobicity.

The three pyrethroids, *viz* permethrin, deltamethrin and lambdacyhalothrin that are commonly used for bednet impregnation and an insect repellent, N, N-diethyl phenylacetamide (DEPA), devel-

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oped at VCRC (Kalyanasundaram, 1982) were used in this study. The present communication deals with the residual efficacy for repellency and adulticidal effect of the treated clothing against *Aedes aegypti*.

MATERIALS AND METHODS

Cotton fabrics with different levels of hydrophobicity were prepared at M/s Anglo French Textiles, Pondicherry by treating them with amino silicon at concentrations 10, 20, 30 and 40 g/l. The wettability of the treated cotton fabrics was studied by following the standard method (ISI, 1963).

Aminosilicon treated cloth with different levels of hydrophobicity was cut into five pieces with an approximate surface area of 1,800 cm^2. Four pieces were treated with synthetic pyrethroids, permethrin (25% EC), deltamethrin (2.8% EC), lambda-cyhalothrin (2.5% EC) and a repellent, DEPA (25% EC) at the application rates of 500, 25, 25 and 500 mg(ai)/m^2 following the standard method (Schreck and Self, 1985). Insecticide impregnated fabric pieces were dried under shade, packed in plastic bags and properly labeled for the bioassay for repellency/feeding deterrency and adulticidal effects against *Ae. aegypti*.

The repellency/feeding deterrency of the treated clothing was determined by placing a chicken confined in a cage in a colony cage (55.0 × 55.0 × 55.0 cm) before release of two hundred 3-4 days old unfed females of *Ae. aegypti*. In one colony cage, the animal cage containing chicken was partially covered with treated clothing and in the other colony cage, the animal cage was partially covered with untreated clothing to serve as the control. The animals were exposed for 30 minutes and the number of mosquitos fed in the treated cage as well as in the control were collected and counted. The percentage of protection for repellency/feeding deterrency was obtained by using the formula:

$$\%\text{Protection} = \frac{\text{No. fed (control)} - \text{No. fed (treated)}}{\text{No. fed (control)}} \times 100$$

The testing was carried out at weekly intervals and continued until the percentage protection dropped below 50% continuously on three to four occasions.

Residual effect of insecticides in the treated clothing against *Ae. aegypti* was tested following the modified method developed at the VCRC (Rajavel *et al*, 1987). The observed percentage mortaility was corrected using Abbotts' formula (WHO, 1963). The bioassay was continued until the observed mortality dropped below 50% continuously for three weeks.

RESULTS AND DISCUSSION

Results showed that increasing the aminosilicon level from 10 to 40 g/l increased the time taken for wetting the fabric from 2.05 to 12.5 seconds (Fig 1).

The results of the cotton clothing at different hydrophobicity levels for repellency/deterrency showed that the aminosilicon treated clothings enhanced the residual effectiveness to last for 7.5-17.5 weeks against *Ae. aegypti* (Table 1). The results showed that there was an increasing trend in repellency/feeding deterrency with the increase in hydrophobicity upto 17.5 weeks at an optimum level of 30g/l.

The observed repellency could be due to the greater availability of insecticides/repellent on the surface of the treated clothing. The increased hydrophobicity could probably minimize the loss of the active ingredient due to absorption into innersurface. The pyrethroids permethrin, lambda-cyhalothrin and the repellent DEPA were equally effective as repellents at 30 g/l and the effect lasted for 17.5 weeks; whereas deltamethrin treated clothing showed repellent effect for 13 weeks.

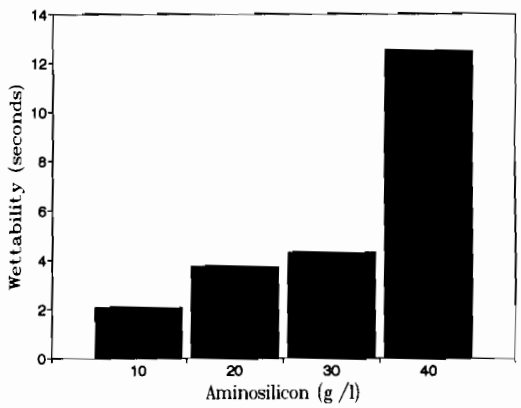

Fig 1–Wettability of cotton clothing of different hydrophobicity.

Table 1

Repellency/feeding deterrency effect of cotton clothing of different hydrophobicity and treated with three synthetic pyrethroids and DEPA against *Aedes aegypti* (weeks). n = 2

Insecticide/ repellent	Hydrophobicity (g/l) (SD)*			
	10	20	30	40
Permethrin	8.50 (0.50)	13.00 (1.00)	17.50 (0.50)	17.50 (0.50)
Deltamethrin	9.00 (0.00)	11.50 (0.50)	13.00 (1.00)	11.50 (5.50)
Lambdacyhalothrin	11.00 (0.00)	11.50 (0.50)	17.50 (0.50)	14.50 (2.50)
DEPA	10.00 (0.00)	11.50 (1.50)	17.50 (0.50)	7.50 (1.50)

* (SD) - Mean with standard deviation

Since people generally use cotton cloth as curtains/screens to cover the windows, doors, etc, for privacy, the insecticide treatment with cotton clothing at increased hydrophobicity levels would reduce the number of mosquitos entering the house thereby reducing man-vector contact as reported earlier by Darriet *et al* (1984) in their study with the impregnated cotton netting with pyrethroids.

The results of the adulticidal effect of the insecticide/repellent impregnated cotton clothings are given in Table 2. The adulticidal effect lasted for only 1-4 weeks. The reduced level of residual efficacy for adulticidal activity may be due to the increased repellency exhibited by the treated clothing. The adult mosquitos might have avoided the contact with the treated surface due to the excito-repellency which resulted in the observed lower adulticidal activity. The reduced mortality in relation to increased excito-repellency was also reported by Lines *et al* (1987).

Thus the results of the study showed that the increased hydrophobicity of the cotton fabrics could enhance the availability of the treated agent on the surface. Therefore these fabrics may serve as curtains/window screens to reduce the man-vector contact.

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Table 2

Adulticidal acitivity of cotton clothing of different hydrophobicity against *Aedes aegypti* (weeks). n = 6

Insecticide/ repellent	Hydrophobicity (g/l) (SD)*			
	10	20	30	40
Permethrin	4.17 (1.95)	2.17 (2.41)	3.17 (2.54)	2.67 (1.80)
Deltamethrin	4.33 (1.37)	3.17 (2.54)	2.83 (2.27)	3.17 (2.19)
Lambdacyhalothrin	3.17 (2.91)	1.50 (1.12)	2.67 (2.69)	3.00 (2.00)
DEPA	2.50 (1.98)	2.17 (1.67)	2.00 (2.00)	3.17 (3.18)

* (SD) - Mean with standard deviation

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