STUDIES ON THE EFFECT OF LAMBDACYHALOTHRIN ON
ANOPHELES MACULATUS THEOBALD AND ITS RESPONSE TO
RESIDUAL SPRAYING AT JERAM KEDAH, NEGERI SEMBILAN,
MALAYSIA

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Abstract. A field trial was carried out to study the effect of lambdacyhalothrin on Anopheles maculatus in trap huts in Jeram Kedah, Negeri Sembilan, Malaysia. Two trap huts were built, of which one was sprayed with lambdacyhalothrin at a dosage of 25 mg ai/m² and the other served as control. Eight collectors commenced collecting mosquitoes from 1900 to 2400 hours, two each indoors and outdoors. Bioassay was also carried out in the treated and control huts to determine susceptibility of adult mosquitoes to lambdacyhalothrin. In the treated hut more mosquitoes were present during the pre-spraying period. Lambdacyhalothrin gave a mortality of 100% against An. maculatus for 8 months.

INTRODUCTION

Malaria continues to be a public health problem among the rural and aboriginal populations living in the interior in hilly cleared jungles. Anopheles maculatus is considered the most important vector of malaria in Peninsular Malaysia. In Malaysia residual house spraying using DDT emulsifiable concentrate at 2 gm/m² has been carried out as part of the malaria control program since 1967.

The present policy is to continue applying DDT (2 cycles per year) as the principal antimalaria measure in malarious areas (VBDCP, 1988). Studies indicate that DDT is still effective against An. maculatus in Peninsular Malaysia (Loong et al, 1989). There is also evidence to suggest that the effect of DDT house spraying reduces man-vector contact through its deterrent and irritant effects rather than through its effect on the vector's longevity (Colless, 1953; Cheng, 1968).

The development of mosquito resistance to chemical insecticides is making the control of mosquitoes and the diseases they transmit more difficult. As such, studies on newer insecticides for vector control is relevant to the overall vector control strategy in this country. Synthetic pyrethroids, being effective at low dosage and having a low mammalian toxicity offer promise as candidates for vector control.

Thus the objective of the present trial was to study the effect of lambdacyhalothrin on An. maculatus in trap huts.

MATERIALS AND METHODS

The study was undertaken in an Aboriginal village in the State of Negeri Sembilan, which lies to the south of Kuala Lumpur. The study area, Kampung Asli Jeram Kedah is situated on the west coast of Negeri Sembilan bordering the state of Selangor. It is a hilly area surrounded by rubber and fruit trees. The inhabitants are Aborigines living in bamboo or wooden huts with zinc or attap roofs. The wooden floors of the houses are usually raised about 0.6 m to 1.2 m above ground level. The houses are scattered about in the area, usually in the clearings of the foot hills.

This kampong was selected for the study as malaria cases were reported regularly from this area and also entomological investigations had shown a reasonable density of An. maculatus in this kampong.

Experimental huts

Two trap huts were built with attap roofs among the houses in Jeram Kedah. The plan of the huts were similar to that used by Thevasagayam et al (1979). Each hut was 3.5 m long, 2.6 m
wide, had 2.4 m high walls with a roof 3 m high at
the highest point. The wooden floor was raised
0.76 m above the ground. The walls were of wooden
plank and roof of attap. Each hut had a door
2 m x 1 m and five entry louvers each 1.8 m x 0.6 m
with louvers at an angle of 30° to the vertical and
3.8 cm apart. Four exit traps of the cone type each
38 cm cube were fitted one to each side of the hut.
One of the huts was intended as the test hut which
was sprayed with lambdacyhalothrin and the
other as unsprayed control hut.

Insecticide

Lambdacyhalothrin, a broad spectrum insecticide
and the most active enantiomer of cyhalothrin, is
a novel photostable pyrethroid. It is effective as a
contact and stomach poison at low rates against a
wide range of insect pests (Jutsum et al, 1984). It
can be used to give rapid knockdown or persistent
residual protection. Lambdacyhalothrin has only
moderate acute mammalian toxicity and is listed
in the WHO (1988) pesticide classification as
being only "moderately hazardous" (class II) like
most other pyrethroids and other well-known
insecticides such as BHC, DDT, Chlorpyrifos and
fenithrothion. The acute oral LD50 is 79 mg/kg for
male rats and 56 mg/kg for female rats. Acute der-
mal toxicity on male and female rats is 632
mg/kg and 696 mg/kg respectively. Technical lambdacy-
halothrin is Ames-negative in mutagenicity tests
(Lim and Visvalingam, 1990).

Methods of collection

The study was carried out from November
1990 to June 1992. Before spraying lambdacyha-
lothrin, both huts were operated simultaneously
for about five months to detect possible differences
in attraction to An. maculatus. Subsequently in
April 1991 one hut was sprayed with lambdacyha-
lothrin wettable powder at a dosage of 25 mg
ai/m². The other hut served as control. Eight col-
lectors commenced collecting mosquitos biting/land-
ing from 1900 to 2400 hours, two each in-
doors and outdoors. After 2400 hours two collectors
slept in the hut under mosquito nets. The follow-
ing morning, adult females caught in the exit traps
were transferred to paper cups and observed for
mortality 24 hours later. The floor of the hut was
also searched for dead mosquitos. All mosquitos
cought were dissected and examined for infection
and parous rate.

Bioassay procedure

Bioassay was carried out in the treated and
control huts at regular intervals of about 1 month
using the WHO standard test method of insecticidal
deposits on wall surfaces with some modifications
to determine susceptibility of adult mosquitos to
insecticides (WHO, 1970). Transparent plastic
conical chambers, 5.8 cm in diameter at the base
and 5.5 cm high, were used as exposure chambers.
Fifteen An. maculatus Jeram Kedah strain bred in
the insectary of IMR were collected using a suction
tube and introduced into conical chambers fastened
to the walls by blowing gently. After 10 minutes
exposure, the mosquitos were transferred to paper
cups covered with netting. Cotton pads soaked
with sugar and vitamin B complex solution were
placed on the nettings of the cups. It was ensured
that a high humidity was maintained during the
holding period. Mortality readings were recorded
24 hours later.

Excito repellency tests

According to WHO (1975) irritability can be
measured by the excito-repellency test box. This
method measures the irritant as well as the toxic
effect exercised by an insecticide used in a formu-
lation similar to that used in the field. The box
similar to that described by Rosendall (1989) was
used. The control box was lined with unsprayed
absorbent poster paper and the test box was lined
with similar paper sprayed with lambdacyhalothrin
wettable powder at 25 mg ai/m².

Sugar fed laboratory bred An. maculatus was
used for the study. The test was conducted in a
dark room with a very dim light. The mosquitos
were released into the box through the funnel of
the exit trap. The funnel opening was closed for 5
minutes during which mosquitos could adapt
themselves to the environment. After opening the
funnel, mosquitos were collected from the exit
trap at intervals of 10 minutes during a total period
of one hour. A flash light was used to facilitate
collection of mosquitos from the exit trap with an
aspirator. The box was opened at the end of the
test period by carefully lifting the removable lid.
All living and dead mosquitos still in the box were
collected and counted. 30 mosquitos were used
per test and six replicates were carried out.
RESULTS

During the pre and post spraying periods An. maculatus was biting more outdoors than indoors. However in the treated hut the numbers indoors was higher than the control hut before spraying commenced. After spraying there was a sudden increase of An. maculatus outdoors and then there was a reduction in the biting rate and with time the biting rate increased as shown in Fig 1. The peak biting season seems to be around April-May and this coincides with heavy rainfall during the previous month. There seems to be a smaller peak around September-November.

The peak biting time for An. maculatus was found to be between 2100 and 2300 hours as shown in Fig 2. Earlier all-night catches were carried out but later this was stopped as very few mosquitoes were caught after 2400 hours. This peak biting time coincides with the study carried out by Wallace (1948) and Wharton (1951). No mosquitoes were found in the exit traps throughout this study.

A total of 1,938 An. maculatus were dissected for malaria infection during the period 1990 to 1992. Two were positive for gland infection, one from indoor collection with a sporozoite rate of 1.4% and the other from outdoor collection with a sporozoite rate of 0.05% giving an overall infection rate of 0.1%. Of the 1,938 dissected, 1,938 were also examined for parity. The parous rate was 55.4%.

Table 1 shows the percentage mortality of An. maculatus in treated and control huts. Lambdacyhalothrin gave a mortality of 100% against An. maculatus for 8 months. At the 9th month the mortality was 96% and subsequently the mortality dropped.

In Table 2 the combined results of 3 replicates of the excitotoxicity repellency tests with an unsprayed and six replicates with a sprayed test box are presented. The escape rate was highest from the sprayed box for the first 20 minutes. After that almost no additional escapes were observed. 100% of the mosquitoes that remained in the control box for 1 hour were alive, while in the treated box 88.5% were dead.

DISCUSSION

While it is widely accepted that newer insecticides will not match the residual efficacy of DDT (Goose, 1983), the problem of vector resistance and behavioral change has necessitated a change from DDT. Presently, synthetic pyrethroids are preferred chemicals used widely in vector control operations in many parts of the world. These chemicals are
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Table 2

Results from the excito-repellency tests with unsprayed and lambdacyhalothrin sprayed test boxes.*

<table>
<thead>
<tr>
<th>Type of test box</th>
<th>Mosquitos remaining in test boxes; % of total number</th>
<th>No. still in box; 1 hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10 20 30 40 50 60</td>
<td>Alive  Dead  % Dead  No of rep</td>
</tr>
<tr>
<td>control</td>
<td></td>
<td>98.9 90 90 90 90 90 81 0 0 88.5 3</td>
</tr>
<tr>
<td>sprayed</td>
<td></td>
<td>90 85 82 82 82 82 17 131 6</td>
</tr>
</tbody>
</table>

* Percentages of An. maculatus remaining in the boxes after intervals of 10 minutes with a total exposure time of 1 hour are presented, together with the number of living and dead mosquitos in the boxes at the end of the experiment.

assuming increasing importance by virtue of their high potency and quick knock down effects against vector insects and low toxicity/hazard to warm-blooded animals. Among these, lambdacyhalothrin was developed during the 1980s for Public Health use.

In the present study no attempt was made to compare DDT to lambdacyhalothrin but rather to assess the residual effectiveness of the latter. With only 10 minutes exposure time lambdacyhalothrin gave a mortality rate of 100% up to 8 months. These results are comparable to other studies carried out in various parts of the world (Barodji et al, 1989; Shrestha et al, 1989; Asinas et al, 1991). In the Philippines Asinas et al (1991) showed that lambdacyhalothrin gave a residual effect of up to 8 months on wood surfaces against An. flavirostris. It was also found that the people preferred lambdacyhalothrin to DDT as it also controlled other domestic pests especially bed bugs and cockroaches as well as the lack of smell or staining. Studies in Brazil showed mortality indices of An. darlingi, 12 months after spraying, of only 53% for DDT compared to 91% for lambdacyhalothrin (Alecrim et al, 1989).

Although fewer mosquitoes were caught in the sprayed hut compared to the control hut, there was no significant difference (p > 0.05). Some workers have shown that DDT and permethrin have repellent effects on Anopheles species (Cullen and Zulueta, 1962; Bondareva, 1984; Han and Loong, 1989). However the results from the excito repellency tests showed that lambdacyhalothrin did not have any repellent effect with An. maculatus as most of them remained in the box and died at the end of 1 hour.

To avert the rapid development of vector resistance to DDT and other insecticides, WHO recommended a number of measures which are "designed to delay or prevent resistance level rising to those at which the pesticide must be abandoned, while maintaining effective disease control" (WHO, 1992). Included in these measures is the rotation of insecticides which is based on the premise that if two pesticides are used sequentially the level of resistance to one will fall while the other is being used. This is with aim, of course, of prolonging the useful life of available insecticides and at the same time achieving an optimal cost/efficacy ratio.

For the above reason and from the results obtained in this trial it is recommended that large scale field trials be carried out in this country to study the effectiveness of lambdacyhalothrin in relation to malaria transmission, vector density and sporozoite rate.

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