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Field Evaluation of *Litsea elliptica* Extract and Bifenthrin by ULV Spraying Against Dengue Vectors

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Abstract

Litsea elliptica extract (Family Lauraceae) and bifenthrin were evaluated against sentinel sugar-fed adult and 4th instar larvae of *Aedes aegypti* in a housing estate endemic for dengue/dengue haemorrhagic fever. The impact of ULV spraying with both plant extract and synthetic pyrethroid showed adulticidal effects. *L. elliptica* extract caused 96.5-97.6% mortality among *Ae. aegypti* adults, bifenthrin 98.1-99.1%, and control indicated 13.2-13.9% mortality, respectively. There was no significant difference between *L. elliptica* and bifenthrin ($P > 0.05$) but each was significantly different from the control ($P < 0.005$). However, ULV spraying with both *L. elliptica* extract and bifenthrin indicated low larvicidal effects.

Keywords: *Litsea elliptica,* bifenthrin, ULV spraying, adulticidal, larvicidal, dengue vectors

Introduction

In Southeast Asia, *Aedes aegypti* (L) has been incriminated as a primary vector *of* dengue viruses and *Ae. albopictus* (Skuse) as a secondary vector [1-4]. Dengue infections may be associated with fatalities, usually among children [4-5].

Properly applied and timed, ultra-low-volume (ULV) insecticide application could be effective in suppressing dengue vectors in times of an epidemic [6]. Chemicals derived from plants are promising for future mosquito control programs [7]. The search for new environmentally safe, target-specific insecticides is being conducted worldwide. To find new modes of action and to develop active agents based on natural products, efforts are being made to isolate, screen and develop phytochemicals possessing pesticidal activity [8]. In Malaysia, *Melaleuca cajuputi* (Family Myrtaceae) and *Cymbopogon nardus* (Family Graminae) extracts have been evaluated in the field against dengue vectors [9]. Both extracts had potential as control agents for *Aedes* spp in the field. Similarly, the potential of *Piper aduncum* extract (Family Piperaceae) was successfully evaluated for dengue vectors in the field [10].

The objective of this study was to compare the efficacy of the plant extract *Litsea elliptica* and bifenthrin using ULV spraying against dengue vectors in high-rise flats in Bandar Baru Sentul, Kuala Lumpur.

Materials and methods

Three blocks of a housing estate composed of 17 storey high-rise flats in a dengue endemic area of Bandar Baru Sentul were chosen for this study. The first block was treated with the plant extract *Litsea elliptica* at a concentration of 0.01 gm/m², a second block with bifenthrin 80 g/L SC at a concentration of 0.01 gm/m² and the third block with water containing 0.1% acetone only, which served as the control. Spraying was conducted using LECO/Model 1600 cold aerosol generator ULV machine mounted on a landrover at the ground level. The sprayer head nozzle was pointed at an angle of 45° to horizontal plane. The flow rate of the ULV application was 104 ml/min (3.5 fl oz/min) and a vehicle velocity of 6 km/hr (3.7 mph). The spraying route covered a distance of 260 m around each building block. Thus, ULV spraying was conducted from the ground level with the spray nozzle pointing towards the building. The plant extract and pyrethroid were sprayed with ULV four times over 2-3 months interval at 1700 h. Teflon coated slides were placed inside each flat to measure the droplet size.

Mortality and knockdown of caged four-day old sugar-fed *Aedes aegypti* were used to evaluate the efficiency of the plant extract and the commercial synthetic pyrethroid. Cylindrical screened sentinel cages (26 cm long x 18 cm wide) each contained 25 sugar-fed female *Ae. aegypti*. Cages were hung inside a room in each flat and outside at 1.5 m above the floor. A sugar cube was placed on top of each cage for *ad lib* feeding. Two flats in each of the level 1, 3, 5, 7, 9, 11, 13, 15 and 17 of each block of high-rise flats were chosen at random for the study, respectively. Thus, alternate levels of the 17 storey were selected for placing the cages. In addition, bottle containers (5.7 x 6.5 cm) each containing 25 4th instar *Ae. aegypti* larvae in water were placed on the floor against the wall inside and outside each of the above flats selected. Both the screened cages and the bottle containers were left for 1 hr after ULV spraying application. The number of larvae and adults knock-down were recorded in the field. They were brought back to the laboratory and recorded on their mortality 24 hrs after ULV spraying. Data analysis used the least significant difference test [11].

Results and discussion

Table 1 showed the corrected knockdown and mortality of *L. elliptica* and bifenthrin using the Abbott's formula. Both *L. elliptica* extract and bifenthrin were significantly different from the control for adult knockdown and mortality inside and outside the flats ($P < 0.05$). However, there was no significant difference between *L. elliptica* extract and bifenthrin ($P > 0.05$). The knockdown effects of *L. elliptica* extract and bifenthrin on *Ae. aegypti* adults were 33.2-33.5% and 31.7-39.3% inside and outside the flats, respectively. *Ae. aegypti* adult mortality by ULV spraying with *L. elliptica* extract and bifenthrin were 96.0-97.2% and 97.8-98.9% inside and outside the flats, respectively. Thus, the *L. elliptica* extract had the potential to control adult *Ae. aegypti* mosquitoes in the field.

Both *L. elliptica* extract and bifenthrin were

Table 1 Knockdown and mortality effects of ULV spraying with *Litsea elliptica* extract and bifenthrin against sentinel *Aedes aegypti* adults and larvae in high-rise flats.

Treatment	Adults				Larvae			
	Mean 1-hr knockdown (%)		Mean 24-hr mortality (%)		Mean 1-hr knockdown (%)		Mean 24-hr mortality (%)	
	outside	inside	outside	inside	outside	inside	outside	inside
Litsea elliptica	33.5*a	33.2*a	96.0*a	97.2*a	0.7a	0.4a	0.5a	0.6a
Bifenthrin	39.3*a	31.7*a	97.8*a	98.9*a	1.9b	0.9a	1.7b	1.6b
Control	0*	0*	0*	0*	0.2a	0.2a	0.8a	0.6a

Mean within a column followed by the same letter are not significantly different ($P > 0.05$); least significant difference [11].
*Corrected according to Abbott's formula.

not effective as larvicide when applied by ULV spraying. The knockdown and mortality for *Ae. aegypti* larvae by *L. elliptica* extract were 0.4-0.7% and 0.5-0.6%, respectively, while those for *Ae. aegypti* by bifenthrin were 0.9-1.9% and 1.6-1.7%, respectively. Thus, both *L. elliptica* extract and bifenthrin at 0.01 gm/m² delivered by ULV were not effective as larvicides.

Droplet size (VMD) for each floor was uneven, ranging from 65 µ (3rd floor of the building sprayed with bifenthrin) to 92.5 µ (3rd floor of another building sprayed with *L. elliptica* extract) (Tables 2 and 3). The percentage mortality for *Ae. aegypti* adults throughout the floor levels was high, ranging from 92.0% (1st floor) to 99.5% (3rd and 7th floors) for *L. elliptica* extract, and 96.3% (17th floor) to 99.5% (13th floor) for bifenthrin. The adult mortality for *Ae. aegypti* among the control group was in the range 10.5% (3rd floor) to 14.5% (1st floor) (Table 2). The impact of *L. elliptica* extract and bifenthrin on the mortality of *Ae. aegypti* showed both the plant extract and the insecticide to be promising in controlling dengue vectors in high-rise flats. *L. elliptica* extract also showed some knockdown effect, in the range 36.5-52.3%, and bifenthrin 38.0-55.3%, (Table 2). However, both *L. elliptica* extract and bifenthrin had low-level larvicidal effects by ULV spray (Table 3). Thus, ULV spraying with *L. elliptica* and bifenthrin was not effective for controlling *Ae. aegypti* larvae. However, a study of *L. elliptica* extract's effects on *Ae. aegypti* in the laboratory indicated LC_{50} = 17.4 µg/ml and LC_{90} of 157.2 µg/ml [12].

In a previous field trial in Malaysia against *Ae. aegypti* adults using *Piper aduncum* extract, 80.7 and 85.7% mortality were found inside and outside flats, respectively [10]. The present study using *L. elliptica* extract caused 97.6% adult *Ae. aegypti* mortality inside and 96.5% outside the flats. Thus, *L. elliptica* extract had higher adulticidal activity on *Ae. aegypti* adults than *P. aduncum* extract. In Malaysia, a study was conducted on the adulticidal activity of some Malaysian plant extracts against *Ae. aegypti* in the laboratory, using the WHO bioassay tests. *L. elliptica* methanol fraction displayed good adulticidal properties (LC_{50} = 0.1 mg/cm², LC_{90} = 6.1 mg/cm²). The LC_{50} results indicated that the methanol fraction of *L. elliptica*

Table 2 Mean knockdown and mortality of *Ae. aegypti* adults on each floor.

Floors	Droplet size (µ)		*Litsea elliptica*		Bifenthrin		Control	
	L. elliptica	Bifenthrin	Knock-down (%)	Mortality (%)	Knock-down (%)	Mortality (%)	Knock-down (%)	Mortality (%)
1	83	70	36.5	92.0	38.3	99.0	16.8	14.5
3	92.5	65	52.3	99.5	48.8	99.3	11.5	10.5
5	96	88	40.0	98.3	47.0	98.8	15.0	13.5
7	90	76	47.0	99.5	55.3	99.3	11.8	12.5
9	88	89	45.3	97.0	43.0	98.8	15.0	13.3
11	85	87	41.0	97.0	47.5	97.3	11.8	12.8
13	92	77	43.8	96.0	44.5	99.5	14.8	12.8
15	90	85	37.8	97.0	38.0	99.0	13.0	12.3
17	87	88	38.0	97.3	36.0	96.3	12.5	12.3

Table 3 Mean knockdown and mortality of *Aedes aegypti* larvae on each floor.

Floors	Droplet size (μ)		*Litsea elliptica*		Bifenthrin		Control	
	L. elliptica	Bifenthrin	Knock-down (%)	Mortality (%)	Knock-down (%)	Mortality (%)	Knock-down (%)	Mortality (%)
1	83	70	0.3	0	0	1.5	0	0
3	92.5	65	0.5	0.5	0	1.0	0.3	0.3
5	96	88	0	0.3	1.8	1.5	0	1.0
7	90	76	0.5	0.5	3.3	1.5	0.8	0.3
9	88	89	2.0	0	1.3	2.0	0	0.5
11	85	87	0.3	1.3	2.0	3.0	0.3	1.3
13	92	77	0.8	0.5	2.5	1.5	0.3	1.8
15	90	85	0.3	1.3	2.0	1.8	0.3	1.0
17	87	88	0.3	0.8	0	1.3	0	0.3

was most potent, compared with *Acorus calamus* extract, *Piper aduncum* extract and malathion [13]. This study indicated that *L. elliptica* extract, like bifenthrin, can potentially be used in the control of *Ae. aegypti* adults in a housing estate in the field. This will enhance the further use of botanical insecticide in vector control.

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