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Dengue vector surveillance in urban residential and settlement areas in Selangor, Malaysia

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Abstract. Ovitrap surveillance was conducted in two urban residential areas (Taman Samudera Timur and Taman Samudera Selatan) and in a settlement area (Kampung Banjar), which is located 16 km from Kuala Lumpur city center, Malaysia. In Taman Samudera, dengue cases were reported monthly in 2003/2004. Thus, a study was initiated to determine the distribution and abundance of dengue vectors, *Aedes aegypti* and *Ae. albopictus*. The ovitrap surveillance indicated that *Ae. aegypti* and *Ae. albopictus* were present both indoors and outdoors. The residential sites had 73 – 79 % of the ovitraps with just *Ae. aegypti* population and Kg. Banjar had 56 % of the ovitraps with just *Ae. aegypti*. In the indoor and outdoor of the residential areas, together with the settlement area, the *Ae. aegypti* density was significantly more than *Ae. albopictus* ($p < 0.05$) by 3 – 50 folds. There was no significant difference in the larval numbers of *Ae. aegypti* between indoors and outdoors ($p > 0.05$), thus implicating that adult gravid female *Ae. aegypti* are present both indoors and outdoors and they do oviposit indoors and outdoors. *Ae. aegypti* can be incriminated as the principal dengue vector in the urban residential site, Taman Samudera and in the settlement area, Kg. Banjar.

INTRODUCTION

Dengue is endemic in Malaysia. The disease is found mainly in the urban and suburban areas. *Aedes aegypti* (Linnaeus) and *Aedes albopictus* (Skuse) have been involved in the transmission of classical dengue fever (DF) and dengue haemorrhagic fever (DHF) in many urban areas of South-east Asia (Smith, 1956; Hammon, 1966; Rudnick, 1967).

In the year of 2003/2004, there were 8,548 reported dengue cases, with 24 deaths in the nation. Selangor state had highest with 3,132 cases (2,978 DF and 154 DHF cases). The cases increased by 287.3% in the 1st quarter of 2005 in comparison to the corresponding period in the previous year (Vector Control Unit of Selangor, Malaysia, 2004, unpublished data). Between 1st January and 9th April 2005, 12,813 people were hospitalized with DF and DHF. The disease claimed 41 lives. Statistics for the first 14 weeks of this year showed that Selangor state recorded the highest number of DF and DHF cases, 5,028 cases with 17 deaths (New Sunday Times, 24 April 2005).

Ae. aegypti and *Ae. albopictus* are the incriminated dengue vectors in Malaysia (Lo & Narimah, 1984; Yap, 1984; Lee & Cheong, 1987; Rebecca, 1987; Chan & Counsilman, 1985; Lam, 1993; Lee & Inder, 1993). Experimental results in studies on the possibility of transovarian transmission of dengue virus in *Ae. aegypti* and *Ae. albopictus* has been reported by Lee *et al.* (1997). Rohani *et al.* (1997) has isolated and detected dengue virus from mosquitoes larvae collected from dengue high risk areas. Thus confirmed the maintance of the virus in the larval stage through transovarian transmission.

The objective of this study was to determine the distribution and abundance of both *Ae. aegypti* and *Ae. albopictus* in a dengue endemic site in the Selangor State. The Selangor State provided the list of weekly reported dengue cases in each of their residential sites under their jurisdiction. Taman Samudera which is located 16 km from Kuala Lumpur city center, had weekly reported dengue cases in 2003/2004. Thus, this site was chosen for the study.

MATERIALS AND METHODS

Description of study sites

Taman Samudera is located 16 km from Kuala Lumpur city center. It is enclosed by Karak Highway and Batu Cave Road. Taman Samudera (TS) is divided into TS Timur (East), TS Barat (West), TS Selatan (South) and TS Utara (North). Each section is separated by dual carriage roads. Ovitrap surveillance was concentrated in TS Timur and TS Selatan as these 2 sites had reported dengue cases. Each site has approximately 200 double story terrace houses. The enviromental condition is generally clean.

The settlement area, Kg. Banjar is located at the entrance of the TS Timur. Two hundred houses were crowded into a 4 ha site. The houses were mostly constructed from wood and had piped water supply. The drainage system was poor and discarded rubbish was observed throughout this site.

Ovitraps surveillance

Ovitraps as described by Lee (1992a) was used in this surveillance. The ovitrap consists of 300 ml plastic container with straight, slightly tapered sides. The opening measures 7.8 cm in diameter, the base diameter is 6.5 cm and the container is 9.0 cm in height. The outer wall of the container is coated with a layer of black oil paint. An oviposition paddle made from hardboard (10 cm x 2.5 cm x 0.3 cm) was placed diagonally into each ovitrap. Each ovitrap was filled with tap water to a level of 5.5 cm.

Ovitrap were placed in 10 % of the houses in TS Timur and TS Selatan, i.e. 20 houses per site. The houses were chosen randomly. Ovitraps were placed indoor and outdoor. In this study, "indoor" is referred to the interior of the house, while "outdoor" is referred to outside of the house but confined to the immediate vicinity of the house (Lee, 1992b).

In Kg. Banjar, 30 ovitraps were placed. As it was not possible to differentiate indoors from outdoors in this overcrowded site, the 30 ovitraps were placed randomly without any differentiation of indoors and outdoors.

All the ovitraps were collected after 5 days and replaced with fresh ovitraps and paddles. Six continuous ovitrap surveillance was conducted.

Identification of larvae

The collected ovitraps were brought back to the laboratory and the contents were poured into a plastic container, together with the paddle. Fresh water was added into the container and the larvae allowed to breed in the laboratory for another 9 days. The container was kept covered. A small piece (10 mm) of fresh beef liver was added into each container as larval food. The hatched larvae were subsequently counted and identified at 3^{rd} instar. The numbers of larvae were recorded individually for each positive ovitrap.

Data analysis

Data was analyzed as such:

(i) Ovitrap Index, (OI), the percent number of positive ovitraps to the total number of recovered ovitraps was determined for each ovitrap surveillance.

(ii) Mean Number of *Ae. aegypti* and *Ae. albopictus* larvae per total number of recovered ovitrap was also determined.

All levels of statistical significance were determined at $P < 0.05$ using t-test.

Table 1. Ovitrap index and larval numbers (mean ± SE) per ovitrap observed

Site		Ovitrap index, %	Larval numbers per ovitrap (mean number ± SE)	
			Ae. aegypti	*Ae. albopictus*
Taman Samudera Timur	Indoor	36.45 ± 4.14	9.59 ± 2.67	0.19 ± 0.14
	Outdoor	43.05 ± 6.16	8.89 ± 2.01	1.77 ± 0.62
Taman Samudera Selatan	Indoor	44.95 ± 6.05	11.86 ± 2.15	1.85 ± 0.77
	Outdoor	48.53 ± 5.90	7.63 ± 1.72	2.94 ± 0.66
Kg. Banjar	Indoor / Outdoor	53.96 ± 5.04	8.88 ± 2.17	3.08 ± 0.67

Table 2. Distribution of *Aedes* population in the ovitraps

Study site	Ovitrap placement	No. of collected ovitrap	Total positive ovitrap	Percent positive ovitrap (%)		
				Ae. aegypti	*Ae. albopictus*	Mixed breeding
Urban residential sites (TS Timur and TS Selatan)	Indoor	195	81	79.01	16.05	4.94
	Outdoor	203	95	72.63	21.05	6.32
Settlement area (Kg. Banjar)	Indoor / Outdoor	143	75	56.00	24.00	20.00

RESULTS

Table 1 describes the ovitrap index and the larval numbers obtained per ovitrap in TS Timur, TS Selatan and Kg. Banjar. Settlement area had a higher OI (53.96%) than the residential sites, but it was not significant ($p > 0.05$). In the residential sites, the outdoor had a higher OI than the indoor but this was again not significant ($p > 0.05$).

The mean larval numbers per ovitrap indicates that *Ae. aegypti* was significantly more in population than *Ae. albopictus* for both residential sites and settlement area ($p < 0.05$) by 3 to 50 folds. The *Ae. aegypti* population was significantly higher both indoors and outdoors ($p < 0.05$). However, *Ae. aegypti* population is significantly not different between indoor and outdoor ($p > 0.05$). This implicates that gravid female *Ae. aegypti* adults were present both indoors and outdoors.

Table 2 describes the distribution of *Aedes* population in the ovitraps. In the 6 ovitrap surveillance, the residential sites had 73 to 79 % of the ovitraps with just *Ae. aegypti* population; and Kg. Banjar had 56 % with just *Ae. aegypti*. In the residential sites, 4.94 to 6.32 % had mix populations of *Ae. aegypti* and *Ae. albopictus*, with Kg. Banjar having 20 % mixed population. This surveillance indicates that *Ae. aegypti* is the principle dengue vector in the urban residential sites and the settlement area.

DISCUSSION

According to Foo *et al.* (1985) and Sucharit *et al.* (1978), *Ae. aegypti* is strictly domiciliary, preferring less vegetation, biting indoor and primarily found indoors, while *Ae. albopictus* is found commonly outdoors and breeds in all types of natural containers. Our studies showed that gravid *Ae. aegypti* female were present both indoor and outdoor without any significant difference. Similar results were reported by Lee (1991) from a nationwide survey that was conducted from 1988 – 1989. *Ae. aegypti* has replaced *Ae. albopictus* as an outdoor breeder. Hawley (1988) also found that in some larger cities in Southeast Asia, *Ae. aegypti* has become a dominant domestic mosquito, replacing the previously common *Ae. albopictus*.

Dengue is a disease associated with slum areas, where breeding of *Aedes* mosquitoes is most prevalent (Chan & Counsilman, 1985). However, this ovitrap surveillance showed that *Aedes* mosquitoes are not only associated with slum areas, but it is also associated with the residential area. The settlement site has numerous natural and artificial containers providing good larval habitats. But the residential sites were generally a clean environment, with minimal natural containers. All the houses have piped water supply. Thus, there was no necessity for the residents to store water. From our observation, the residential sites had minimal natural containers. The only possible larval habitat for *Aedes* mosquitoes was the concrete drainage system outside the houses. The drains had clear stagnant water with fallen leaves and other debris. Lee's studies in 1990 and 1991, found that *Aedes* larvae required clear, but not necessarily clean water and this was provided by the stagnant clear water in the drain. The drains served as good artificial larval containers for *Ae. aegypti*. The drain water were tested collected from TS Timur for their suitability to colonize *Ae. aegypti* immature by Moo *et al.* (2005, unpublished data). It was evident that the drain waters supported the colonization from eggs to pupae. The pupae emerged into healthy adults.

Integrated vector control is the common approach for dengue vector control. Source reduction must be implemented in the study sites to prevent the weekly / monthly dengue cases. As for the settlement area, the sanitary disposal system must be improved, together with the drainage system. In the residential sites, water must be prevented from stagnating in the drains. Thus, not providing a larval habitat for *Ae. aegypti*.

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