

# Indoor-Breeding of *Aedes albopictus* in Northern Peninsular Malaysia and Its Potential Epidemiological Implications

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## Abstract

**Background:** The mosquito *Ae. albopictus* is usually adapted to the peri-domestic environment and typically breeds outdoors. However, we observed its larvae in most containers within homes in northern peninsular Malaysia. To anticipate the epidemiological implications of this indoor-breeding, we assessed some fitness traits affecting vectorial capacity during colonization process. Specifically, we examined whether *Ae. albopictus* exhibits increased survival, gonotrophic activity and fecundity due to the potential increase in blood feeding opportunities.

**Methodology/Principal Findings:** In a series of experiments involving outdoors and indoors breeding populations, we found that *Ae. albopictus* lives longer in the indoor environment. We also observed increased nighttime biting activity and lifetime fecundity in indoor/domestic adapted females, although they were similar to recently colonized females in body size.

**Conclusion/Significance:** Taken together these data suggest that accommodation of *Ae. albopictus* to indoor/domestic environment may increase its lifespan, blood feeding success, nuisance and thus vectorial capacity (both in terms of increased vector-host contacts and vector population density). These changes in the breeding behavior of *Ae. albopictus*, a potential vector of several human pathogens including dengue viruses, require special attention.

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## Introduction

The acquisition of indoor-breeding behavior can potentially increase the biting activity of mosquito vectors that opportunistically bite humans outdoors during the day. This may therefore have important implications to disease transmission. However, despite this epidemiological importance, there have been no previous studies of this issue in dengue vectors.

Dengue viruses infect up to 50 million people each year, causing more than 20,000 deaths [1,2]. These flaviviruses are mainly transmitted by *Aedes aegypti*, but also *Ae. albopictus* [3]. Native to the Oriental Region and some islands in the Indian Ocean [3], *Ae. albopictus* has become well-established in the Western hemisphere where it is the second main vector of dengue [4]. It is also an important vector of yellow fever and various types of encephalitis virus, as well as a competent vector of at least 23 other arboviruses under laboratory conditions [5,6,7]. It is well adapted to peridomestic environments with its larvae breeding in artificial containers and adults aggressively biting humans and different animals during the day [3].

Efforts to control dengue have mainly involved insecticide spraying programs, but this strategy has proven ineffectual [8].

While a vaccine is currently under development, without immediate prospects for success, vector control remains the only viable method to prevent dengue transmission [9,10,11,12]. Improved knowledge regarding egg-laying behavior is relevant because it underpins the primary surveillance method, i.e., ovitrapping [13,14]. However, the most commonly used ovitrap, the CDC gravid trap, is not appropriate for capturing *Ae. albopictus* [15,16].

Blood feeding in mosquitoes represents phenotypic expression of reproductive investment as it is the acquisition of resources specifically for reproduction [17]. Reproductive output represents the energy allocated to egg production and oviposition that could otherwise be allocated to maintenance of somatic function, and the act of oviposition is associated with a risk to survival [18]. There has been a great deal of research regarding the variations of reproductive investment and outcome. Overall, increases in both number and size of blood meals result in increased individual egg mass and number of eggs [18]. Clearly, in the field an increased frequency of blood uptake will tend to require host – mosquito contact and expose hosts to a greater risk of disease transmission.

*Ae. albopictus* has been occasionally incriminated in dengue epidemics in Asian countries [19,20,21]. The first report of a