UNIVERSITI TEKNOLOGI MARA

RESISTANCE STATUS OF *Aedes albopictus* (Skuse)(Culicidae:Diptera) MOSQUITOES TOWARDS ORGANOPHOSPHATE AND PYRETHROID INSECTICIDES IN SELECTED DENGUE OUTBREAK AND NON OUTBREAK AREAS, SELANGOR

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ABSTRACT

Aedes albopictus is known as a day biting mosquito and a vector of dengue viruses in Malaysia. One of the most effective prevention and control method for dengue currently in practice is the use of insecticides to control adult *Aedes* populations. Nonetheless, this *Aedes* species can develop resistance towards different types of insecticides and threaten vector control programs. In Subang Jaya, the escalating numbers of confirmed dengue cases in recent years suggest that the presence of resistance. Hence this study in the Subang Jaya Municipal area is intended to fill vital gaps in information on the extent of changes in its biological characteristics, development of resistance towards organophosphates and pyrethroids and the expression of metabolic genes. A total of 1,200 ovitraps were placed in 12 dengue outbreak and non outbreak known as hotspots (HS) and non-hotspots (NHS) areas respectively. Analysis of biological characteristics revealed significant differences in fecundity, gonotrophic cycles, duration of immature stages and longevity in mosquito specimens in these two areas. HS *Ae.albopictus* specimens showed enhanced vectorial capacity as compared to NHS specimens. WHO adult bioassays using 4 different types of insecticides against a total of 9,600 individual *Aedes albopictus* mosquitoes collected in HS and NHS areas indicated that the majority of local vector populations were already resistant to Malathion and Permethrin, yet susceptible to Deltamethrin and Lambdacyaluthrin. Analysis of gene expression, using 720 individual *Ae.albopictus* mosquitoes using qRT-PCR procedures, revealed that *Ae.albopictus* was capable of sequestering detoxification enzymes. Most HS mosquito specimen showed high positive amplification of Glutathione – S – Transferase (GST) and Cytochrome P450 (CytoP450). Similar findings were observed for NHS mosquitoes but gene expression was relatively low, indicating that vector populations were still susceptible towards existing insecticides. As for Esterase Lipase (EL) gene only the specimens collected from 2 localities demonstrated amplification, suggesting cross resistance. Risk ratio (RR) calculated for Mortality Rate (Mr) and Knockdown Rate (Kdr), suggested both HS and NHS specimens had equal risk of resistance (RR=1) towards Malathion. Resistance for Permethrin, Deltamethrin and Lambdacyaluthrin were found respectively, to be 1.2, 6.0 and 2.5 times higher among the HS specimens. Multivariate analysis employing 15 parameters, confirmed that there were significant differences of parameters tested in both HS and NHS specimens with Bonferroni adjusted p – value of $\alpha < 0.003$. In conclusion, this study revealed significant differences in resistance status and underlying resistance attributes in *Aedes albopictus* obtained across Subang Jaya municipal areas. Therefore it appears that current mitigation measures, for managing dengue outbreaks using insecticides, may no longer be effective.

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CHAPTER ONE
INTRODUCTION

1.1 THE MOSQUITO AND ITS PUBLIC HEALTH IMPORTANCE AROUND THE WORLD

Mosquitoes are commonly known as a major threat to public health as reported all over the world. Numerous genuses of mosquitoes are globally distributed with some of it restricted to endemic regions obviously indicate their biodiversity (Rueda 2008). The dengue virus is belongs to genus Flavivirus with four antigenically related but different in dengue virus serotypes; Denv 1 - 4 which can cause dengue fever and dengue hemorrhagic fever (Manorenjitha 2006). Dengue fever is considered as a benign sporadic disease and caused epidemics during the 19th century and yet was still reported to have experienced 30-fold increment in the past five decades. (Manorenjitha 2006). The common fear of mosquitoes comes from their role as vectors that can spread diseases such as Dengue, Chikungunya, Malaria, Filariasis, Yellow fever and Japanese Encephalitis. In that regard, dengue virus transmitted to humans by infected females of *Aedes aegypti* and *Aedes albopictus* is the most common cause of dengue fever worldwide. *Aedes albopictus* is known to be a vector of more than 30 viruses including dengue virus (Lambrechts et al. 2010).Mosquitoes larvae can live in a variety of habitats like fresh water, brackish water or any other body of water that is clear, turbid or polluted with the exception of high-salt concentration areas such as marine habitat. (Saleeza et al., 2011). *Aedes aegypti* variants are commonly found indoors, while *Aedes albopictus* are usually found outdoors, in open spaces with shaded vegetation and suitable breeding sites such as car tires, and garbage dumps. *Aedes albopictus* is capable of breeding in both natural and artificial containers with the habitat selected based on the accessibility to obtain food and complete the reproduction development. (Hartman 2011). World Health Organization stated that, *Ae. albopictus* has spread from Asia to other continents such as America and Europe through the international trade in used tires where eggs are hatched when there is water, these eggs are also able to resist desiccation and remain viable for several months (World Health Organization 2006).