

## Molecular Mechanism of mosquito resistance to Insecticide: Perspective in Indonesia

Din Syafruddin

Malaria and Vector Resistance Laboratory, Eijkman Institute for Molecular Biology, Jalan Diponegoro 69, Jakarta 10430, Indonesia, Department of Parasitology, Faculty of Medicine Hasanuddin University, Jalan Perintis Kemerdekaan Km 10, Tamalanrea, Makassar, 90245, Indonesia

The global efforts to control malaria have successfully reduced morbidity and mortality of malaria around the world. The World Health organization (WHO) estimated that a cumulative 1.2 billion fewer malaria cases and 6.2 million fewer malaria deaths occurred globally between 2001 and 2015. However, many challenges, such as the emergence of artemisinin-resistant *Plasmodium falciparum* and insecticide-resistant mosquito vector threat the current malaria elimination efforts. During the year of 2013-2014, the Ministry of Health deployed a total of 1 million long lasting insecticide-treated nets (LLINs) in five provinces of eastern Indonesia that includes Papua, West Papua, Moluccas, North Moluccas and East Nusa Tenggara Provinces. Despite of several reports of insecticides resistance in certain parts of Indonesia, the malaria incidence continued to decrease within the last 5 years (Ministry of Health report, 2015). Insecticides are an effective and practical tool for reducing malaria and other mosquito-born diseases transmission but the development of resistance to the insecticides can potentially compromise controls efforts. Resistance to insecticides includes several mechanism such as behavioral resistance, penetration resistance, metabolic resistance and altered target site resistance. Resistance to pyrethroids and organophosphates compounds, two of the most commonly used insecticides are spreading worldwide and affecting the *Anopheles*, *Aedes* and *Culex spp.*, vectors of many mosquito-born diseases such as malaria, filariasis, Dengue, Zika, and other arthropod-born viruses. Molecular studies within the last few years have identified several Single Nucleotide Polymorphisms (SNPs) in the mosquito gene that are associated with the resistance, i.e., *kdr* allele of voltage-gated sodium channel (VGSC) gene for resistance to pyrethroids and the *ace1a* gene for resistance to organophosphate. The molecular basis for metabolic resistance is less explored. Genetic mutation (s) and increase in copy numbers of genes that are involved in the metabolisms of the insecticides have been documented. To circumvent the rapid emergence of mosquito resistance to insecticide, a new paradigm in the mosquito control program is being explored through the use of spatial repellent that principally not killing the target insect but only repel it out of the human dwelling. This approach is thought does not select for resistant mosquitoes. Several early studies have documented promising results of this approach and larger clinical trial to determine its potential use in the control of mosquito-born diseases is now underway.

**Key words:** mosquito-born diseases, and insecticide resistance and spatial repellent