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The Resistance Status of Aedes aegypti against Insectisides in Medan Indonesia

[1] Nurfadly, Department of Parasitology, University of Muhammadiyah Sumatera Utara, Medan, Indonesia.
[2]Zahir Husni, University of Muhammadiyah Sumatera Utara, Medan, Indonesia
[3]M.Teguh Syahputra, University of Muhammadiyah Sumatera Utara, Medan, Indonesia
[4]Rido Rais Hutabarat, University of Muhammadiyah Sumatera Utara, Medan, Indonesia
Corresponding Author: Dr. Nurfadly, M.KT, Department of Parasitology, University of Muhammadiyah Sumatera Utara, Medan, Indonesia.

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Abstract

Background : Aedes aegypti is the main vector of several diseases such as Dengue Hemorrhagic Fever (DHF), Yellow Fever, Chikungunya Fever and Zika Fever. Various efforts to control the Aedes aegypti have been carried out to prevent transmission of the diseases. One of the efforts to eradicate adult mosquitoes is by spraying (fogging) insecticides. The use of irrational insecticides can trigger insecticide resistance in Aedes aegypti.

Objective: The objective of this study is to determine the resistance status of Aedes aegypti to insecticides in Medan Indonesia

Methods: The type of research used in this study is descriptive research with cross-sectional methods, using 276 larvae of Aedes aegypti. Insecticide resistance test using susceptibility test and continued with enzyme acetylcholinesterase activity test by biochemical testing.

Result: The results of this study are Aedes aegypti larvae which were susceptible (sensitive) to insecticides were 66.3%, while Aedes aegypti larvae that are tolerant (moderate resistance) of insecticides are 33.7% and resistant (high resistance) Aedes aegypti larvae were not found.

Conclusion: The most Aedes aegypti mosquito larvae in Medan are still sensitive to organophosphate insecticides, but there are Aedes aegyti mosquito larvae that are tolerant (moderate resistant) to organophosphate insecticide so it is important to prevent the increase in the number of resistant mosquito larvae.

Keyword: Aedes aegypti, insecticides, resistance

Introduction

Aedes aegypti is the main vector of several diseases such as Dengue Hemorrhagic Fever (DHF), Yellow Fever, Chikungunya Fever and Zika Fever.[1] This mosquito is widespread in almost all tropical regions of the world.[2] Efforts to control the Aedes aegypti are mainly aimed at breaking the chain of transmission by eradicating adult mosquitoes by spraying (fogging) insecticides.[3]

Some areas in Indonesia were still often found fogging that was not on target, not sustainable, did not refer to information about vectors and even incorrect doses. This was can trigger insecticide resistance in Aedes aegypti mosquitoes in some areas.[4]

Insecticides are divided into: organic insecticides (derived from nature) and synthetic organic insecticides. Synthetic organic insecticides consist of organic chlorine groups (DDT, clorden, BHC, dieldrin, linden), organic phosphorus groups (parathion, malathion, temephos, diazinon, DDVP, phenitrotion, dipterex), nitrogen organic group (dinitrophenol), sulfur group (carbamate) and thiocyanate group. The types of insecticides commonly used in vector control include organophosphate, carbamate and pyrethroids. In controlling DHF, insecticides which are often used are organophosphate. In this research, susceptibility of Aedes mosquito larvae to organophosphate insecticide by bioassay and biochemical test.[4,5]

Methods

This study was a descriptive study with a cross-sectional method. This study aims to determine the resistance status of Aedes aegypti larvae from several areas in the city of Medan, including: Medan Selayang, Medan Area and Medan Denai against organophosphate insecticide. Aedes aegypti mosquito larvae samples totaled 276, were collected directly from the breeding place, aiming to avoid mosquito larvae not from the same parent, so it did not have the same resistance to insecticide. The identification of Aedes aegypti mosquito larvae was carried out at the Laboratory of Parasitology at the Faculty of Medicine, University of Muhammadiyah Sumatra Utara.

Procedure

Bioassay tests were carried out on all mosquito larvae that had been collected using temephos 6.25 mg / L which had been previously dissolved with 249 ml of distilled water to obtain a concentration of 0.02 mg / l (according to WHO standards). Temephos is an organophosphate insecticide. Aedes aegypti mosquito larvae were put into a beaker glass containing temephos 0.02 mg / L and allowed to stand for 1 hour. After 1 hour, the dead larvae are collected and counted the number of dead larvae, as well as the surviving larvae collected and counted. The dead larvae were considered to be susceptible (sensitive) larvae and the surviving larvae are resistance to organophosphate insecticides. To prove whether the surviving larvae are tolerant (moderate resistance) or resistant (high resistance) a biochemical test is carried out. Biochemical tests were performed using QuantiChromTM Acetilcholin Esterase Assay Kit.

Result

The Aedes aegypti mosquito larvae collected were tested for bioassay, the results were as follows:

Table 1 Bioassay test result on Aedes aegypti larvae

Result	Number	Resistance status
Live larvae	93 (33,7%)	Resistance
Dead larvae	183 (66,3%)	Sensitive
Total	276 (100%)	

Table 1 showed that 276 Aedes aegypti mosquitoe larvae were tested using temephos 0.02 mg / L, it was found that 93 larvae of Aedes aegypti lived and 126 larvae died. The dead larvae are susceptible (sensitive) larvae to organophosphate insecticides. While the larvae that live are larvae that are resistant to organophosphate insecticides.

The surviving larvae put into a beaker glass containing clean water for further biochemical test.

In the biochemical test all mosquito larvae were included in the tolerant group (moderate resistance).

Discussion

In figure 1, it can be seen that the resistance status of Aedes aegypti larvae collected from several houses in Medan, larvae that sensitive to organophosphate insecticide were 183 (66.3%), larvae that tolerant of organophosphate insecticides were 83 (33.7%) and the resistant larvae were not found.

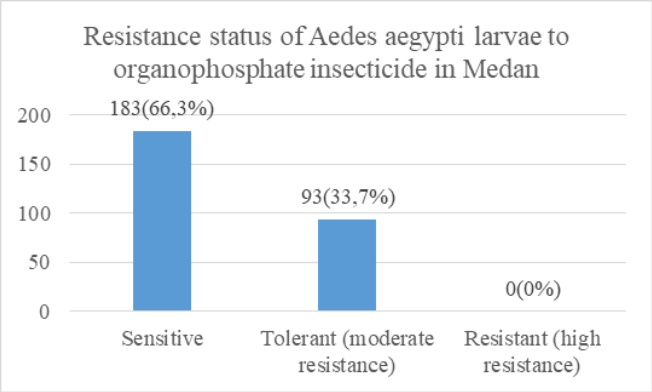

Figure 1: Resistance status of Aedes aegypti larvae to organophosphate insecticide in Medan

Based on the results of the study, it was found that 33.7% of Aedes aegypti larvae were tolerant of organophosphate insecticides. The occurrence of resistance to insecticides in insects were influenced by several factors. Genetic factors are genes that encode the formation of the esterase enzyme, which can cause insect resistance to insecticides.

Biological factors include biotics (the existence of a monogamous or polygamous, the change of generations and at the end of the development of each generation of natural insects), the behavior of insects such as migration, isolation, monophagi or polifagi and the ability of insects to protect against danger or changes in behavior. Operational factors, including chemical material used in vector control and insecticide applications in the form of application, frequency and duration of use.[6]

Based on research about resistance of Aedes aegypti to organophosphate insecticides, it states that the use of organophosphate insecticides for a long time and with sublethal doses will induce resistance to the active substance.[7]

In general, the mechanism of insect resistance to insecticides is on the basis of physiological and genetic changes through thickening of the cuticles, metabolic mechanisms and changes in the target side. Metabolic mechanism is the main resistance mechanism of Aedes aegypti against organophosphates, where there is an increase in the activity of the esterase enzyme which will hydrolyze organophosphates before reaching the target side of acetylcholinesterase.[8,9]

In this study it was found that about 33.7% of mosquito larvae have shown to be tolerant of organophosphate insecticides, for this reason it needs to be prevented from spreading. This is important to control the use of insecticides according to the rules. Periodically replacing organophosphate insecticides with other insecticides that do not contain ester groups such as pyretroit and biopesticides. In addition, it can also replace the use of organophosphate groups with other bioinsecticides such as the bacterium *Bacillus thuringiensis israeliensis*. The use of Bacillus thuringiensis israeliensis is reported to be effective as a control for dengue hemorrhagic vector (DHF) for both larvae and adult mosquitoes is a good alternative to reduce the use of chemical insecticides.[10]

Other ways to control mosquito larvae by using natural predators are mosquito larvae such as cupang fish (*Ctenops Vittatus*), kepala timah fish (*Panchax panchax*) can reduce the number of mosquitoes that bite humans.[11]

Individual physical-mechanical control can be carried out using repellent, using long-sleeved clothing and long pants, also by using mosquito nets at bedtime.[3]

The common way in Indonesia to eradicate the habitat of mosquitoes through the 3M movement : draining the water tub (**m**enguras) , closing potential places to breed (**m**enutup), burying used goods that can hold water (**m**engubur). Abatisasi water reservoirs such as bathtubs, ponds, water pots have been carried out. Conceptually the movement to eradicate mosquito nests (PSN= Pemberantasan Sarang Nyamuk) with 3M once a week is sufficient to cut the life cycle of the mosquito.[10]

Conclusion

In this study was concluded that the most Aedes aegypti mosquito larvae in Medan are still sensitive to organophosphate insecticides, but there are Aedes aegyti mosquito larvae that are tolerant (moderate resistant) to organophosphate insecticide so it is important to prevent the increase in the number of resistant mosquito larvae.

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