Status Resistance of *Aedes aegypti* (Diptera: Culicidae) to Temephos (Organophosphat) In Tanjung Bingkung, Solok, West Sumatera

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Abstract:
Temephos is already used equally in Indonesia. Despite having used temephos as a larvacide, Ae. aegypti mosquitoes continues to proliferate and spread the dengue virus. This is evidenced by the increasing number of people suffering from dengue fever. This study aims to determine the status and mechanism of resistance that occurs in Ae. aegypti located in Tanjung Bingkung, Solok, West Sumatera. To determine the status of resistance is done susceptibility test. The results stated that Ae. aegypti contained in Tanjung Bingkung Solok, West Sumatra has been resistant to temephos with larval mortality 78%.

Keywords: Dengue Hemorragic Fever; *Ae. aegypti*; Temephos; Resistance.

1. INTRODUCTION

Mosquitoes belong to insect classes known as vector diseases in animals and humans. Dengue Fever (DHF) is one example of disease transmitted by mosquito genus Aedes, especially *Aedes aegypti*[1].

Various efforts in the handling of DHF has been done, one of them by using insecticides. Use of insecticides is expected to control *Ae. aegypti* which acts as a vector of DHF spreaders. One of the insecticides used in *Ae. aegypti* control is temefos. The use of temefos in various countries has been done since the 1970s [2]. While in Indonesia the use of temefos to combat larvae *Ae. aegypti* has been done since 1976 and in 1980 temefos has been established as an insecticide used in the mass eradication of larvae *Ae. aegypti* [3].

The use of insecticides that were initially effective if used continuously will lead to resistance and become ineffective in killing insects. Resistance is a form of insect defense that causes insecticides have no effect on the body of insects. Insect defense can be an increase in detoxification enzyme activity associated with mutations in the gene encoding the enzyme [4].

Ae. aegypti resistance case has been reported from various countries in the World including in Indonesia. The results of the study revealed larvae Ae. aegypti that can be in the city of Bogor, Tasikmalaya, Sumedang, Garut, and Semarang have been resistant to temefos [5].

Cases of resistance to temefos also occur in West Sumatra. Larvae *Ae. aegypti* obtained in Dharmasraya district, and Pauh sub-district of Padang, West Sumatra have also been resistant to temefos based on susceptibility test with larval mortality percentage less than 90% [6-7]. Temefos has also been used for control *Ae. aegypti* in nagari Tanjung Bingkung district of Solok, West Sumatra. Despite using temefos as a larvacid, dengue fever cases in this nagari continue to increase until now [8]. Therefore, it is necessary to study resistance against *Ae. aegypti* located in nagari Tanjung Bingkung district of Solok, West Sumatra. This study may provide information on the status and causes of resistance *Ae. aegypti* that can support DHF vector control process.

2. RESEARCH METHODOLOGY

2.1 Research Methodology

The research method used is the experimental method with the test of vulnerability (Successability Test) which refers to WHO standard. Larvae *Ae. aegypti* was taken in november 2017 in nagari Tanjung Bingkung Solok, West Sumatera. The sample in the test is larvae *Ae. aegypti* instar III.

2.2 Suceptability Test

The susceptibility test is performed by Bioassay method. 250 mL plastic cups filled with water and added temephos with concentrations of 0.005 mg/L, 0.012 mg/L, 0.018 mg/L and 0.025 mg/L separately with a total volume of 100 mL. After that, the larvae were put as many as 25 tails on each plastic cup. This treatment was performed with 4 replications and 1 control. Determination of 50% lethal dose and 95% begins with preliminary test first. Lethal concentrations (LC) sought were 50% and 95% mortality (LC50 and LC95). Observations were made during 24 hours of treatment. larvae *Ae. aegypti* is categorized as resistant if the percentage of larval deaths in test glass is <90% [9].

2.4 Data analysis

The percentage of death was analyzed by the following formula;
(%) Death= (number of Dead larvae)/ (Amount Test Larvae)X 100%

Lethal concentration (LC) is calculated by
using a computer program called Probit Analysis Program. To determine the vulnerability status of larvae can be used criteria based on WHO standard as follows;
Resistant if death <90%
Tolerant if death 90-97%
Vulnerable if death 98-100% [10]

3. Results and Discussions

3.1 Results

3.1.1 Uji Kerentanan

Number of deaths of larvae *Ae. aegypti* after exposure temefos for 24 hours at each test concentration can be seen in Table 1. as follows;

Table 1. Percentage of Death *Ae. aegypti* from Tanjung Bingkung, Solok of West Sumatra to temefos After 24 hours observation .

Concentrations of temefos (mg/L)	Amount of sample	Number of Larvae Dead (tail)	Percentage of Larva Deaths (%)	Standard Error (SE)	Min.	Max.	Std. deviation	Resistance Status *
Control	25	0	0	0	0	0	0	-
0,005	25	3	12	0,79	0	6	2.581989	Resistance
0,012	**25**	19.5	**78**	0,53	18	22	1.732051	Resistance
0,018	25	23.25	93	0,29	22	24	0.957427	Tolerance
0,025	25	24	96	0,25	23	25	0.816497	Tolerance

* the resistance status refers to the concentration used.

Table 1. shows that the larvae *Ae. aegypti* contained in Tanjung Bingkung, Solok of West Sumatra is categorized as resistant to the death of 78% larvae at diagnostic concentrations established by WHO (0.012 mg/L).

Determination of sensitivity level *Ae. aegypti* to temefos can further be known through probit analysis. From the analysis results obtained the value of temefos concentration that can be used to control WHO. The LC values can be seen in Table 2. as follows;

Table 2. The value of LC temephos against *Ae. aegypti* Tanjung Bingkung, Solok of West Sumatra.

LC	Concentrations of temefos (mg/L)	Standard Error (SE)
50	0,0099	0,0005842
95	0,0202	0,0012351
98	0,0228	0,0014829

Table 2. shows that to kill 50% of larvae *Ae. aegypti* at Tanjung Bingkung, Solok, West Sumatera needed temefos with concentration 0,0099 mg / L, to kill 95% larvae *Ae. aegypti* is needed temefos with a concentration of 0.0202 mg / L, and to kill 98% of larvae *Ae. aegypti* is needed temefos with concentration 0,0228 mg / L.

3.2 Discussion

larvae *Ae. aegypti* contained in Tanjung Bingkuang, Solok regency of West Sumatra is categorized as resistant to the death of 78% larvae at diagnostic concentrations established by WHO (0.012 mg / L). According to WHO (2016) if a population of larvae is controlled with 0.012 mg / L temefos and death <90% after exposure to the insecticide then the population is said to be resistant. Temefos 0.012 mg / L as larvacide should kill> 98% of larvae *Ae. aegypti* due to temefos exposure to larvae *Ae. aegypti* can lead to the process of accumulation of acetylcholine in the muscle to circulate throughout the body to cause death in the larvae [10].

The use of temefos with concentrations established by WHO is no longer effective in controlling the Ae larvae. aegypti allegedly because temefos has been used since the 1980s as larvasida in Solok regency, West Sumatera[8]. The case of resistance occurring in Tanjung Bingkuang Kabupaten Solok is higher when compared to the resistance occurring in Cupak Tangah and Kampung Dalam Dharmasraya District which is the percentage of Ae larvae mortality. aegypti against temefos 0.012mg / L 95% and 100%[6]. In other words larvae *Ae. aegypti* in Cupak Tangah and Kampung Dalam Dharmasraya Regency is still ranging from vulnerable to tolerant, in contrast to Tanjung Bingkuang Solok Regency that has been resistant. This happens because of environmental differences, community habits and differences in temefos exposure to larvae *Ae. aegypti* in each region. The level of resistance is higher in Tanjung Bingkuang Kabupaten solok one of them due to the water source that people use for daily activities is rain water. They have no source of water like clear water wells that rely on rainwater. Therefore, cleansing of water reservoirs is rarely done. Tub draining activities are only done when the rain comes. This results in *Ae. aegypti* can breed well on the container. Another case with the inner and outer areas of Dharmasraya districts where people tend to use well water in daily activities so that to drain the bath tub does not need to wait for the rain.

the results of the probit analysis show that to kill 50% of larvae *Ae. aegypti* in Tanjung Bingkuang, Solok regency of West Sumatera required temefos with concentration 0,0099 mg / L, to kill 95% larvae *Ae. aegypti* is needed temefos with a concentration of 0.0202 mg / L, and to kill 98% of larvae *Ae. aegypti* is needed temefos with concentration 0,0228 mg/L.While the recommended temefos concentration of WHO (2016) to kill > 98% larvae *Ae. aegypti* is 0.012 mg / L. this differs considerably from the concentration required to control 98% of larvae *Ae. aegypti* in Tanjung Bingkuang, Solok District, West Sumatera. This means that the concentration of temefos should be increased so that the larvae can be controlled.

3 Conclusion

From the results of research on larvae *Ae. aegypti* obtained in nagari Tanjung Bingkung Solok, West Sumatera in 2017 can be concluded that the larvae *Ae. aegypti* has been resistant to temefos.

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