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Effectiveness of temephos against *Aedes aegypti* larvae based on lethal concentration (LC_{50}, LC_{90}, and LC_{98}-48 hours) and lethal time (LT_{50}, LT_{90}, and LT_{98})

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Abstract
Dengue Hemorrhagic Fever is spread by *Aedes aegypti*. This disease tends to increase every year and its spread is getting wider. The use of temephos is an effort to control *Ae. aegypti* larvae. The purpose of this research is to know the value of Lethal Concentration (LC_{50}, LC_{90}, LC_{98}-48 Jam) and Lethal Time (LT_{50}, LT_{90}, LT_{98}) larvae *Ae. aegypti* against temephos. The method of this research is an experimental study that refers to the WHO standard using 20 *Ae. aegypti* larvae in each experiment. The concentrations of temephos used included 0.003 mg/L, 0.006 mg/L, 0.012 mg/L, and 0.025 mg/L. The results of this research were LC_{50}, LC_{90}, and LC_{98}-48 hours respectively, namely 0.004 mg/L, 0.010 mg/L, and 0.014 mg/L. In addition, the values of LT_{50}, LT_{90}, and LT_{98} at a concentration of 0.003 mg/L respectively were 32.536 hours, 56.198 hours, 69.853 hours. The values of LT_{50}, LT_{90}, and LT_{98} at a concentration of 0.006 mg/L respectively were 28.741 hours, 51.909 hours, 65.665 hours. The values of LT_{50}, LT_{90}, and LT_{98} at a concentration of 0.012 mg/L respectively were 17.804 hours, 33.416 hours, and 44.606 hours. The values of LT_{50}, LT_{90}, and LT_{98} at a concentration of 0.025 mg/L respectively were 12.283 hours, 20.140 hours, 25.670 hours.

Keywords: dengue hemorrhagic fever, insecticides, resistance, aedes aegypti, and vector

1. Introduction
Dengue Hemorrhagic Fever (DHF) is a tropical disease that commonly infects humans. DHF has become a health problem suffered by the international community in recent years [10]. Mosquitoes are a vector that transmits various types of diseases caused by parasites or viruses. DHF is transmitted through mosquito bites, especially the *Aedes aegypti* mosquito [1]. There were 189 cases of DHF in the West Sumatra region in 2019 and 159 cases in 2018 in the Pesisir Selatan area [3].

The controlling of *Ae. aegypti* is necessary to overcome DHF. Control efforts that have been carried out include fogging and the use of chemical insecticides such as temephos. Temephos is larvicidal organophosphate groups recommended by the WHO for use to controlling the *Ae. aegypti* larvae in clean water reservoirs for residents [11, 2]. Temephos is used because it has high killing power, is easy to get, and is commonly used by the public [8]. The use of temephos in the community continuously and repeatedly over a period of decades can lead to the emergence of insecticide resistance, environmental pollution, and disturbance of non-target organisms in the vicinity [9]. The standard for using temephos in Indonesia for larval control is a concentration of 0.012 mg / L as recommended by WHO (2016) [12].

The effectiveness of temephos against mosquitoes can be determined by determining the value of Lethal Concentration (LC-48 hours) and Lethal Time (LT) at each concentration tested [5]. Determining Lethal Concentrations (LC) and Lethal Time (LT) performed to determine the concentration of insecticide and time used in controlling the population of *Ae. aegypti* larvae in Salido Sub-district. Therefore, the purpose of this research was to determine the value of Lethal Concentration (LC_{50}, LC_{90}, and LC_{98})-48 hours and Lethal Time (LT_{50}, LT_{90}, and LT_{98}) temephos against *Ae. aegypti* larvae in Salido Sub-district, IV Jurai District, Pesisir Selatan Regency.

2. Materials and Methods
This research is an experimental research. The research sample employed *Ae. aegypti* larvae taken in Salido Sub-district Pesisir Selatan. This research was conducted at the Animal Physiology Laboratory, Biology Department, Andalas University, Padang. Testing was carried out according to WHO standards [12] using 20 *Ae. aegypti* larvae for each temephos concentration used. The concentrations of temephos used were 0.003 mg/L, 0.006 mg/L, 0.012 mg/L and 0.025 mg/L. Lethal Concentrations (LC)-48 hours (LC_{50}, LC_{90} and LC_{98}-48 hours) were analyzed from the mortality of *Ae. aegypti* larvae population 50%, 90%, and 98% within 48 hours of exposure. The Lethal Time (LT) values (LT_{50}, LT_{90} and LT_{98}) were analyzed from the length of time of death of *Ae. aegypti* larvae population 50%, 90%, and 98%. The determination of LC and LT values was carried out by means of a *probit analysis* using the *Minitab 14 program.*

3. Results & Discussion
The results of the probit analysis showed that the Lethal Concentration (LC) value of temephos within 48 hours of exposure was correct in controlling *Ae. aegypti* larvae in Salido Sub-district, Pesisir Selatan Regency, West Sumatra which can be seen in Table 1 below.

Table 1: Value Lethal Concentration (LC) *Ae. aegypti* to temephos in an exposure time of 48 hours.

LC	Concentration of temephos (mg / L) ± SE
50	0.004 ± 0.0004
90	0.010 ± 0.0009
98	0.014 ± 0.0012

Data in Table 1 shows that the Lethal Concentration value of 50% (LC_{50}-48 hours) is the concentration of temephos needed to control 50% of *Ae. aegypti* larvae population within 48 hours of exposure requires a temephos concentration of 0.004 mg / L. Furthermore, to control 90% of the population of *Ae. aegypti* larvae needed temephos with a concentration of 0.010 mg / L, and then to control 98% of the population of *Ae. aegypti* larvae needed temephos with a concentration of 0.014 mg / L.

Based on Table 1, to control 98% of *Ae. aegypti* larvae population, a temephos concentration of 0.014 mg / L is required. This concentration is 1.16 times higher than the WHO recommended concentration of 0.012 mg / L. It shows that the increase in DHF cases in Salido Sub-district is thought to be caused by the insecticide temephos which is not effective in controlling the *Ae. aegypti* larvae population at the concentration determined by WHO [4]. Determination of Lethal Time (LT) with probit analysis was carried out to determine the appropriate insecticide exposure time to control the *Ae. aegypti* larvae population. The Lethal Time (LT) values to control 50%, 90%, and 98% of the population of *Ae. aegypti* larvae in Salido Sub-district, Pesisir Selatan District, West Sumatra (LT_{50}, LT_{90}, and LT_{98}) can be seen in Table 2 below.

Table 2: The value of LT Temephos against larvae Ae. aegypti Salido Sub-district, Pesisir Selatan Regency, West Sumatra

Concentration	Lethal Time	Time (Hour)
0.003 mg / L	LT_{50}	32.536
	LT_{90}	56.198
	LT_{98}	69.853
0.006 mg / L	LT_{50}	28.741
	LT_{90}	51.909
	LT_{98}	65.665
0.012 mg / L	LT_{50}	17.804
	LT_{90}	33.416
	LT_{98}	44.606
0.025 mg / L	LT_{50}	12.283
	LT_{90}	20.140
	LT_{98}	25.670

Data in Table 2 shows that the longest Lethal Time (LT) value is at the lowest temephos concentration, and conversely the shortest Lethal Time (LT) value is at the highest temephos concentration. LT_{50} values longest currently on temephos concentration of 0.003 mg / L of 32.536 hours while the shortest LT_{50} values are at temephos concentration of 0.025 mg / L of 12.283 hours. LT_{90} values longest currently on temephos concentration of 0.003 mg / L of 56.198 hours while the shortest LT_{90} values are at temephos concentration of 0.025 mg / L of 20.140 hours. LT_{98} values longest currently on temephos concentration of 0.003 mg / L of 69.853 hours while the shortest LT_{98} values are at temephos concentration of 0.025 mg / L of 25.670 hours. Based on Table 2 the values of LT_{50}, LT_{90}, LT_{98} for a concentration of 0.012 mg / L are 17.804 hours, 33.416 hours, and 44.606 hours, respectively (Table 2).

The shortest LT_{50}, LT_{90} and LT_{98} values indicated the more effective time to control *Ae. aegypti* larvae [6]. Larval mortality of *Ae. aegypti* is related to the concentration of the temephos insecticide given. The higher the temephos concentration used, the higher the mortality of *Ae. aegypti* larvae. The duration of control is also related to the concentration of the temephos insecticide used. The higher the temephos concentration used, the shorter the exposure time needed to control *Ae. aegypti* larvae [7].

4. Conclusions

The conclusion of this study shows that LC_{50}, LC_{90}, LC98-48 hours were 0.004 mg/L, 0.010 mg/L, and 0.014 mg/L respectively. Furthermore, the values of LT_{50}, LT_{90}, and LT_{98} at a concentration of 0.003 mg/L were 32.536, 56.198, and 69.853 hours, respectively. The values of LT_{50}, LT_{90}, and LT_{98} at a concentration of 0.006 mg/L were 28.741, 51.909, and 65.665 hours, respectively. The values of LT_{50}, LT_{90}, and LT_{98} at a concentration of 0.012 mg/L were 17.804 hours, 33.416 hours, and 44.606 hours respectively. The values of LT_{50}, LT_{90}, and LT_{98} at a concentration of 0.025 mg/L were 12.283, 20.140, and 25.670 hours, respectively.

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6. References

1. Arslan A, Mukhtar M, Mushtaq S, Zakki A, Hammad M, Bhatti A. Comparison Of Susceptibility Status Of Laboratory And Feld Populations Of *Aedes aegypti* Against Temephos In Rawalpindi. Journal of Entomology and Zoology Studies. 2015; 3:374-378.
2. Department of health. Prevention and Eradication of Dengue Hemorrhagic Fever in Indonesia. Director General of P2PL. Jakarta, 2005.
3. West Sumatra Provincial Health Office. 2019 Health Profile. Padang, 2019.
4. Ekawati SN, Hariani N, Sudiastusi S. *Perbandingan Efektivitas Temephos Dengan Bacillus thuringiensis var. Israelensis Terhadap Mortalitas Nyamuk Aedes aegypti Dari 3 Kelurahan di Kota Samarinda*. Al-Kauniyah. 2019; 12(1):46-53.
5. Guomin J, Xiaolin Y, Rongchang C. The Handbook of Insecticide Formulations and Its Technologies for Household and Public Health Uses. Hong Kong: Jin Tai Printing Ltd, 2003.
6. Handito S, Setyaningrum E, Handayani TT. *Uji Efektivitas Ekstrak Daun Cengkeh (Syzygium aromaticum) Sebagai Bahan Dasar Obat Nyamuk Elektrik Cair Terhadap Nyamuk Aedes aegypti*. Jurnal Ilmiah Biologi Eksperimen dan Keanekaragaman Hayati. 2014; 2(2):91-96.
7. Pambudi BC, Martini, Tarwotjo U, Hestiningsih R. *Efektivitas Temephos Sebagai Larvasida Pada Stadium*

Pupa Aedes aegypti. Jurnal Kesehatan Masyarakat (e-Journal). 2018; 6(1):382-388.
8. Polson KA, Rawlins SC, Brogdon WG, Chadee DD. Organophosphate Resistance in Trinidad and Tobago Strains of *Aedes aegypti*. Journal of the American Mosquito Control Association. 2010; 26(4):403-410.
9. Rosmini, Garjito TA, Hayani A, Yudith L, Risti. The Application of Temephos in the Water Reservoir of Regional Drinking Water Companies to the Decrease in the Larva Index *Ae. aegypti* in the City of Palu. Journal of Health Ecology. 2006; 5(1):409-416.
10. Wang WH, Urbina AN, Chang MR, Assavalapsakul W, Lu PL, Chen YH, et al. Dengue Hemorrhagic Fever - A Systemic Literature Review Of Current Perspectives On Pathogenesis, Prevention And Control. Journal of Microbiology, Immunology and Infection. 2020; S1684-1182(20):30067-0.
11. World Health Organization (WHO). Monitoring and Managing Insecticide Resistance in Aedes Mosquito Populations; Interim Guidance for Entomologists. Geneva, Switzerland, 2016.
12. World Health Organization (WHO). Comprehensive Guidelines for Prevention and Control of Dengue and Dengue Haemorrhagic Fever. Jakarta, 2010.