



WATER QUALITY AND DENSITY OF *Aedes* SP LARVAE— A STUDY FROM INDONESIA

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ABSTRACT

The results showed that there was a relationship between water temperature and the presence of larvae with a value of $p = 0.000$, there was a relationship between water pH and the presence of larvae with a value of $p = 0.019$ and there was no relationship between dissolved oxygen (DO) and the presence of larvae with a value of $p = 0.572$. It is expected that the Makassar health department to provide supervision and provide guidance to the community to focus more on eradicating mosquito nests and the community should always pay attention and routinely monitor water quality in water reservoirs that affect the density of mosquito larvae.

Key words: *Aedes* sp, DHF, larvae, water quality, temperature, pH, dissolved oxygen, larval presence, vector control, larval density, pH, dissolved oxygen, public health

Dengue hemorrhagic fever (DHF) is a viral infectious disease that spreads from mosquitoes to humans. The disease is more common in tropical and subtropical climates, and transmitted by *Aedes aegypti* and *Aedes albopictus*. The incidence of DHF has continued to increase annually worldwide in recent decades. WHO reports that DHF is endemic to more than 100 countries, including the Americas, Southeast Asia, and the Western Pacific, which are the worst affected, with Asia representing approximately 70% of the global disease burden, including Indonesia (WHO, 2023). Based on data from the Indonesian Health Profile in 2021 reported that in 2021, the incidence of DHF in Indonesia was 73,518 cases with a total of 705 deaths. Cases and deaths due to DHF have decreased compared to 2020, which amounted to 108,303 cases with 747 deaths. (Kemenkes RI, 2022). The number of cases in 2022 was 143,266 cases, and 1,237 of them died. Reporting from the 33rd week of 2023, the number of dengue cases in Indonesia was 57,884 cases, and 422 of them died. According to P2PM, there are 13 provinces in Indonesia with the highest dengue cases, including Sumatra, the entire island of Java, and parts of Sulawesi, including South Sulawesi, Bali and Nusa Tenggara (Kemenkes RI, 2023).

DHF cases in South Sulawesi in 2019 were 3,747 cases, with a total of 2,002 male patients and 1,745 female patients, which means that the morbidity rate of DHF per 100,000 population is 40.97, which means that there are 40-41 people with DHF in 100,000 population

in South Sulawesi. The incidence of DHF in South Sulawesi Province in 2020 was 2,714 patients with a total morbidity rate of 29.6 per 100,000 population, which means there are 29-30 people with DHF in 100,000 population in South Sulawesi. The highest number of cases was recorded in Gowa Regency, with 457 cases; Maros Regency, with 361 cases; Enrekang Regency, with 219 cases and Makassar City, with 175 cases (Dinkes Sulsel, 2021). DHF cases in Makassar City have fluctuated over the past 5 years. The number of DHF cases recorded in 2018 was 256 cases, then in 2019 it increased to 268 cases, in 2020 it decreased, namely 175 cases, then increased again to 583 cases in 2021 and then decreased again in 2022 to 523 cases (Dinkes Makassar, 2022). The number of cases reported in 2023 that were confirmed according to data from the Makassar City Health Office from January to July 2023 was 318 cases. (Dinkes Makassar, 2023).

The highest number of DHF cases in Makassar City occurred in 2021, which recorded 583 cases with 294 male and 289 female patients. The dengue morbidity rate per 100,000 population in 2021 was 39.3%. There are five sub-districts with the highest cases in 2021, namely Rappocini sub-district (136 cases), Panakkukang sub-district (112 cases), Tallo sub-district (74 cases), Manggala sub-district (66 cases) and Tamalate sub-district (62 cases) (Dinkes Makassar, 2021). Flick-free count (ABJ) is the % of homes or public places without larvae. A low ABJ indicates a high density of larvae and mosquito populations in an area (Kuwa and Sulastien,

2021). Tamalate Health Center is one of the at-risk areas with a larva-free rate of 78.41%, where out of 565 houses inspected, there were 122 positive *Aedes* larvae (Dinkes Makassar, 2023). *Aedes aegypti* mosquito is the main vector of dengue virus, which causes Dengue Fever (Srivastava et al., 2023). The incidence of DHF is influenced by many factors, namely host factors, environmental factors, and infectious and pathogenic factors (viruses) (Ernawati, Ardianto and Syahribulan, 2020). Environmental factors are associated with the presence of *Aedes* sp are life cycle, breeding site, landfill type, rainfall, temperature, humidity, altitude and wind influence. Microenvironmental factors are influenced by the condition of the water in the breeding site, namely temperature, pH and dissolved Oxygen (D.O.) (Scott and Morrison, 2004). Some of these environmental factors can affect female *Aedes* sp mosquitoes in choosing a place to lay eggs, including temperature, pH, D.O. and usually, female mosquitoes choose breeding sites that are not exposed to direct sunlight (Olayemi et al., 2010).

Physical and chemical conditions of water such as pH, water temperature and DO are parameters that affect the growth, survival and adaptation of mosquito larvae. These affect the size, biting habits, egg-laying habits and survival habits of mosquito larvae (Clark, Flis and Remold, 2004; Thorp and Covich, 2010; Hidayah and Rahmawati, 2019a; Medeiros-Sousa et al., 2020) we test the small molecule flexible ligand docking program Glide on a set of 19 non- α -helical peptides and systematically improve pose prediction accuracy by enhancing Glide sampling for flexible polypeptides. In addition, scoring of the poses was improved by post-processing with physics-based implicit solvent MM-GBSA calculations. Using the best RMSD among the top 10 scoring poses as a metric, the success rate ($\text{RMSD} \leq 2.0 \text{ \AA}$ for the interface backbone atoms. Related research was conducted by (Agustina et al., 2019) in Banjarbaru City. The results showed that there was a significant relationship between water temperature and the presence of *Ae.aegypti* larvae (p-value 0.000). Research related to water pH and the presence of *Aedes aegypti* larvae was conducted by (Hidayah et al., 2019) in DHF endemic and non-endemic areas in Banjar Regency. Research related to Dissolved Oxygen (D.O.) in the presence of *Aedes aegypti* larvae was conducted by (Hidayah et al., 2019) in endemic and non-endemic areas of Banjar Regency. This study examines the influence of water quality, in terms of temperature, pH, and Dissolved Oxygen (DO), on the presence of *Aedes* sp larvae that are at risk of spreading dengue. The study

location is Parang Tambung urban village, Tamalate sub-district, Makassar city.

MATERIALS AND METHODS

This type of research is analytically observastional. The population in this study is all houses in Parang Tambung Village, which are as many as 1924 houses. The sample in this study is 104 houses taken based on the slovin formula using the purposive sampling technique (Nurdin and Zakiyuddin, 2018; Abubakar, 2021), which has the following inclusion criteria: houses domiciled in Parang Tambung Village and have a water reservoir. This research has received approval from the Health Research Ethics Committee of the Faculty of Public Health, Hasanuddin University with letter number No: 405/UN4.14.1/TP.01.02/2024

RESULTS AND DISCUSSION

Based on the results of the calculation, it was obtained that each DF value was obtained from the results of the calculation of HI, CI and BI, namely 7, 6 and 7 so that it was categorized that the density of larvae in Parang Tambung Village was classified as high according to the density figure table based on the statement from WHO in (Lesmana and Halim, 2020). This indicates that the potential for dengue virus transmission in Parang Tambung Village is very high (Table 1). The density of *Aedes* sp larvae in Parang Tambung Village is quite high because, from the observations made, many containers do not have covers and the habits of people who rarely drain water reservoirs regularly and rarely clean existing landfills such as buckets, basins and bathtubs. This research is in line with that conducted by (Ariyanto et al., 2020) in Pasar Daya Makassar City; the results of the density figure (D.F.) obtained are 8, which means that the density of *Ae. aegypti* larvae is high.

Water temperature affects the growth and development of mosquito larvae. The optimal water temperature for the development of *Aedes* sp mosquito larvae ranges from 25– 30°C (Suryaningtyas, Margarethy and Desty Asyati, 2017). High temperatures can accelerate viral reproduction and shorten the extrinsic incubation time of the vector (Lahdji and Putra, 2019). Based on the results of the chi-square statistical test, there is a significant relationship between water temperature and the presence of larvae with a p-value of 0.000 ($p < 0.05$). The results of this study are in line with previous research conducted by (Herawati et al., 2022) in Martapura District, Banjar Regency, which concluded

Table 1. Density figure, relationship between water temperature, pH, DO and the presence of *Aedes* sp larvae in Parang Tambung village

Density Figure (DF)					
Indicator	%		Density figure (DF)		
House index (HI)	52.88		7		
Container index (CI)	25.49		6		
Breateau index (BI)	86.53		7		
Water quality					
Water temperature conditions	Presence of larvae				P value
	Positive		Negative		
	n	%	n	%	
Optimum	47	85.4	24	48.9	0.000
Not optimum	8	14.5	25	51.1	
Total	55	100	49	100	
Water pH conditions	Presence of larvae				P value
	Positive		Negative		
	n	%	n	%	
Potential	45	81.8	30	61.2	0.019
Not potential	10	18.2	19	38.8	
Total	55	100	49	100	
DO conditions	Presence of larvae				p value
	Positive		Negative		
	n	%	n	%	
Potential	32	58.2	27	55.1	0.752
Not potential	23	41.8	22	44.9	
Total	55	100	49	100	

that there is a relationship between water temperature in water reservoirs and the presence of *Aedes aegypti* mosquito larvae where the p-value is 0.005. Research is not in line with those conducted by (Ummul, 2023) in Pampang Village, Makassar City, which concluded that there is no relationship between water temperature and the presence of *Aedes aegypti* mosquito larvae with a p-value of 0.588.

The degree acidity (pH) of water is an important factor for the survival and growth of *Aedes* sp. *Aedes* sp mosquitoes cannot survive or will die at pH levels ≤ 3 and ≥ 12 (Suryaningtyas, Margarethy and Desy Asyati, 2017). The alkaline pH level inhibits the growth of adult mosquito larvae by affecting the cytochrome oxidase enzyme. The dissolved oxygen level is higher at low pH and lower at high pH. *Aedes* sp larvae optimally live at pH 7 to 8 (Listiono, Rimbawati and Apriani, 2021). Based on the results of the chi-square statistical test, there is a significant relationship between water pH and the presence of larvae with a p-value of 0.019 ($p < 0.05$). The results of this study are in line with research conducted by (Putra et al., 2019) in Batealit District, Jepara Regency, which concluded that there was a significant relationship between water pH and

the presence of *Aedes aegypti* larvae with a p-value of 0.002. Inconsistent research was conducted by (Listiono et al., 2021) in the Sako Health Center working area of Palembang city which concluded that there was no significant relationship between the pH level and the presence of *Aedes aegypti* larvae with a p-value of 0.235.

Dissolved oxygen is an important factor for *Aedes* larvae, indicating the need for organisms to oxidize organic matter as a source of food and energy (Absharina, Rahadian and Hadi, 2015). Dissolved oxygen levels play a role in the formation of cytochrome oxidase enzymes for mosquito larval metabolism. The acidic water environment increases dissolved oxygen and accelerates the growth of microbes, so that the oxygen demand increases and the oxygen level decreases, interfering with the growth of larvae can even lead to death (Noya, Rahardjo and Prakasita, 2022). Based on the results of the chi-square statistical test, there is no significant relationship between water D.O. and the presence of larvae, with a p-value of 0.572 ($p > 0.05$). Similar research was conducted by (Overgaard et al., 2017) in Columbia, which concluded that there was no relationship between dissolved oxygen levels and the presence of *Aedes aegypti* larvae in water storage containers with a p-value of 0.052. This research is not in line with that conducted by (Rosmanida et al., 2020) in East Java, which concluded that there is a relationship between dissolved Oxygen and the presence of *Aedes* larvae with a p-value of 0.039.

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AUTHOR CONTRIBUTION STATEMENT

All authors contributed equally to the conception and design of the study. All authors read and approved the final manuscript.

CONFLICT OF INTEREST

No conflict of interest

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