Effectiveness of Chlor (Ch) Residual on Hatchability of egg *Aedes* (Stegomyia) aegypti Linn. as Dengue Vector

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Abstract. Chlorine residue aims to kill bacteria that are in the water accordance with Permenkes No. 32 of 2017. This study aims to determine the effect of residual chlor on the hatchability of *Aedes aegypti* eggs with various concentrations. This experimental study was conducted at Entomology Laboratory of Tanah Bumbu Health Research and Development Center in April 2019. Chlorine residual concentrations used were 1 mg / l, 2 mg / l, 3 mg / l, and 4 mg / l with controls. Observations were carried out for 9 days by observing egg hatching in every day. Temperature, pH and humidity are recorded. The results of the study indicate that the calculated value of 0.982 is greater than 0.05, so it can be concluded that the variances of the four treatment and control groups compared were not significantly different. The remaining chlorine used as drinking water and ponds is not able to inhibit the hatching of eggs of *Ae. aegypti* mosquitoes.

Keywords: Cholirine residual, hatchability, *Aedes aegypti*

1 Introduction

Dengue fever (DHF) is a major public health problem in more than 100 tropical and sub-tropical countries in Southeast Asia, the Western Pacific and South and Central America. It is estimated that 50 million cases of dengue occur worldwide. Every year around 500,000 people with Dengue Fever require hospitalization.[1] Over the past 25 years, there has been a global increase in cases of dengue hemorrhagic fever and its distribution has become more widespread over the last few decades. Indonesia is one of the endemic areas in the world, since the discovery of the dengue virus in Surabaya and Jakarta in 1968 the incidence of dengue virus infection increased from 0.05 per 100,000 population to 35.19 per 100,000 population in 1998.[2] Indonesia's DHF Incidence Rate (IR) in 2014 was 39.80 per 100,000 population.[3]

Dengue hemorrhagic fever is transmitted to humans through the bite of an *Aedes* mosquito infected with the dengue virus.[4] *Aedes aegypti* is one species of mosquito vector carrying the dengue virus. *Aedes aegypti* mosquitoes breed rapidly within 7 days to become adult mosquitoes and live in places that can hold water, such as bathtubs, used goods, and other items that collect water.[5], [6]

DHF control is emphasized on vector control to break the chain of transmission.[7] One way that can be done is through the control of larval habitat in water containers. The presence of larvae in water containers is a way to estimate the density of *Aedes* mosquitoes and one of the risk factors for dengue transmission.[3]Water is the source of human life in the world which is also a breeding habitat for various disease vectors, including DHF vectors. Each type of water has certain conditions that can affect the hatching of *Aedes aegypti* eggs. Factors that influence it include pH, temperature, humidity, light, oxygen content, and

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chemicals in water.[8], [9]

Chlorine is a chemical commonly used to purify water. The content of chemicals in water also affects the hatchability of *Aedes aegypti* eggs, the results of the study found that chlorine in water media interferes with the process of egg development and hatching because the chlorine in chlorine is able to oxidize (burn) *Aedes aegypti* eggs by damaging the protein contained in eggs.[10]

Based on this, the Effect of Chlorine Effectiveness on the hatchability of *Aedes aegypti* eggs has been carried out to determine the number of eggs and which hatch into larvae.

2 Research Method

Research with an experimental design was carried out in the Entomology Laboratory, the Center for Research and Development Tanah Bumbu, Indonesia in April 2019. The concentration of chlorine treatments tested were 1 mg / l, 2.5 mg / l, 5 mg / l and 7.5 mg / l with control using aquadest. The treatment was repeated 4 times. Mosquito eggs used are the stock of colonization results in the laboratory which are stored in filter paper sheets. The number of mosquito eggs in 1 treatment was 20 eggs. The treatment solution and mosquito eggs (on filter paper sheets) are placed in a clear glass bowl. Observation of eggs that hatch into larvae is carried out for 9 days accompanied by recording environmental parameters such as temperature and pH of the treatment solution as well as room temperature (^{0}C) and humidity (%).

3 Results and Discussion

The average number of eggs hatched can be seen in Figure 1.

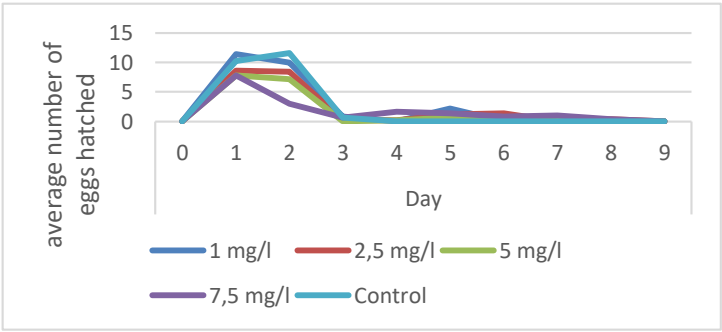

Fig.1. Graphic of the average number of *Aedes aegypti* eggs hatched

Based on the graph above can be seen that the hatching larvae has occurred on a 1 day (1 x 24 hours) after treatment. The lowest average number of hatching larvae on the 1st day was in the treatment of 5 mg / l and 7.5 mg / l chlorine concentration. Furthermore, on the 3rd day of all treatments and controls has a sharp decrease, but the treatment with 5 mg / l chlorine concentration was most prominent. The treatment of 5 mg / l chlorine concentration on the 3rd day have no hatched larvae and so on until the 9th day except on the 4th and 5th days. On the 9th day all treatments and no controls

longer hatched larvae.

Based on the output of the Anova test using SPSS it is known that the sig value is 0.982> 0.05, so it can be concluded that the variants of the four treatment groups thats compared with the control did not significantly different.

Temperature and pH average of the treatment solution for 9 days of observation can be seen in the following figure 2.

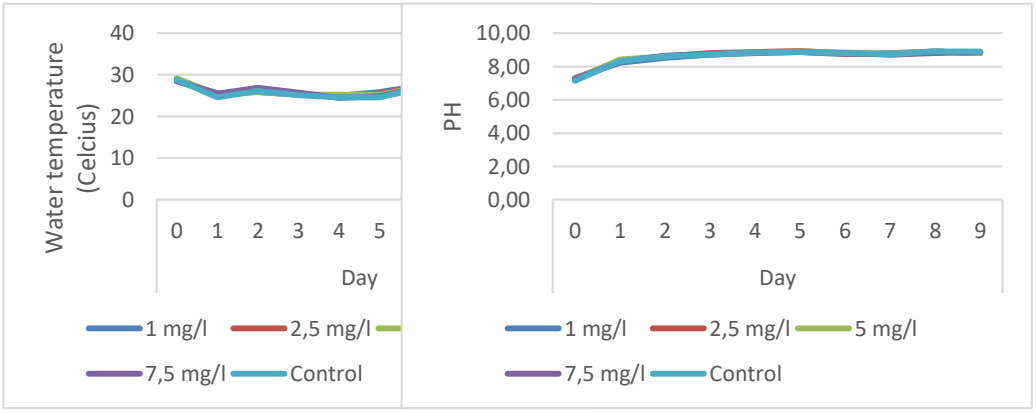

Fig.2. Water temperature and pH graph of the treatment solution

The average of water temperature ranges at 23-30 ^{0}Celsius. Lines on the overlapping graph indicate that there is no large variation temperature for each treatment. The biggest temperature fluctuation occurs on the 7th and 8th days, where on the 8th day the temperature reaches the lowest point and on the 8th day it reaches the highest temperature. The pH of Water from all treatments on average has increased, on the 1st day the pH of water on the lowest point until the 9th day reached its highest point.

The average of room temperature and humidity for 9 days of observation can be seen in the following figure 3.

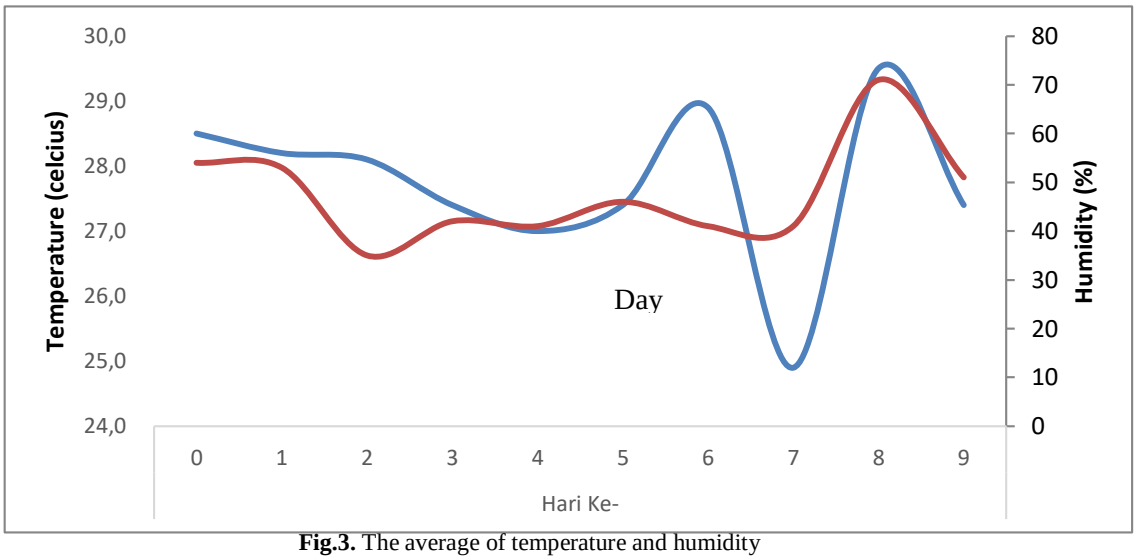

Fig.3. The average of temperature and humidity

There was an extreme change in room temperature on the 6th, 7th and 8th days, where on the 6th day the temperature of 28.9 ºC decreased to the lowest point of 24.9 ºC, but on the 9th day it increased sharply to the highest point to 29.5ºC. The lowest room humidity is 35% occurred on the 2nd day, while the highest is 71% on the 8th day. There was a significant change in humidity from 41% on the 7th day to 71% on the 8th day.

4 DISCUSSION

Based on the results of the tests carried out, there was no significant difference in the number of hatched larvae in the level of chlorine concentration given, but it can be seen in the table that there tends to be a decrease in the average number of larvae that hatch with increasing chlorine concentration. The lowest number of hatched larvae is at 5 mg / l chlorine concentration. Ali, H (2018) was found that higher concentration of chlorine was more effective to inhibit the hatchability of Aedes aegypti mosquito eggs, with chlorine concentration of 18 mg / l was the most effective dose in inhibiting the hatchability of Aedes aegypti mosquitoes with 98% mortality percentage.[10] Aedes aegypti eggs will hatch 80% on the first day and 95% on the second day in normal water conditions.[11] This experiment result show the average number of hatched larvae was less than 80% on the first day of all chlorine concentration. The same thing happened to the control, but the average number of hatched larvae was still highest compared to all chlorine concentration.

Addition of chemicals can damage the morphology or cause abnormalities in the egg so it cannot hatch, in addition to the process of inhibition of egg hatching occurs because chlorine is a disinfectant that can reduce dissolved oxygen needed in the hatching process.[11] Chlorine is very reactive so it easy to react with other compounds and form new compounds such as organochlorines which are toxic compounds for organisms.[12]

Other factors that can directly influence Aedes aegypti life cycle including the development of eggs into larvae are water temperature and pH, air temperature and humidity.[13] Water temperature and water ph, room temperature and room humidity were also measured in this experiment. Aedes eggs in water will hatch in 1-2 days at a temperature of 23^0-^{27oC}[14] and develop well in 25º - 30ºC water temperature.[15] Water temperature ranges in this experiment was average from 23º - 30ºC, it is still in the range of water temperatures optimal for eggs hatch. Larval development will be optimal at water pH 6,0 – 7,5 and larvae will die at pH ≤3 and ≥ 12.[8] Measurement of water pH in this experiment shows pH range at 7,1 – 8,9. The measurement results also show an increase in water ph over time, its lowest point on the first day and highest point on the 9th day. Although the pH of water tends to be higher than the optimal value, it is still in the range that can be tolerated for Aedes aegypti development. The optimum temperature for mosquito to growth is 25^0-27^0C and growth will totally stop in less than 10^0C or more than 40^0C.[11] Aedes aegypti need humidity about 70%.[15] Room temperature that measured in this experiment between $24{,}9^0$ – $29{,}5^0$C while humidity ranges from 35% - 71%, so mosquitoes should still be able to develop properly in this condition.

4 Conclusions

The four treatment groups and control groups compared were not significantly affected. The remaining chlorine that is used as drinking water and ponds is not able to inhibit the hatching of eggs into *Aedes aegypti* mosquitoes.

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