Majalah Kedokteran Sriwijaya, Th. 50
Nomor 4, Oktober 2018

THE INFLUENCE OF CHLORINE TO THE EGG HATCHABILITY OF *Aedes aegypti*

Fajri Irwinsyah M[1*], dr. Dalilah[2], M.Kes, dr. Triwani, M.Kes[3]

[1*]*Mahasiswa kedokteran Universitas Sriwijaya*
[2]*Fakultas Kedokteran Universitas Sriwijaya*
[3] *Fakultas Kedokteran Universitas Sriwijaya*

Abstrak

Aedesaegypti adalah nyamuk yang membawa virus serotip DEN-1, DEN-2, DEN-3, DEN-4, dimana semua serotype ini dapat menyebabkan Demam Berdarah (Lestari, 2007). Tujuan penelitian adalah menganalisis pengaruh konsentrasi kaporit terhadap daya tetas telur *Aedesaegypti*. Hasil penelitian menunjukkan terdapat pengaruh pada berbagai dosis kaporit terhadap persentase penetasan telur *Aedesaegypti*. Makin tinggi konsentrasi kaporit maka ada kecenderungan makin sedikit jumlah telur yang menetas. Penelitian ini adalah penelitian eksperimen dengan rancangan penelitian *post test only group design* dengan berbagai konsentrasi kaporit yaitu 0 mg/l ; 2 mg/l; 4 mg/l; 8 mg/l dan 10,0 mg/l; 12,5 mg/l; 15 mg/l. Data hasil eksperimen akan di analisis statistic yaitu ujinormalitas, uji kruskal wallis dan analisis probit LC 50. Hasil dari uji normlitas didapat bahwa nilai P<0,05 yang artinya nilai tidak normal. Karena nilai p tidak terdistribusi normal maka uji selanjutnya yang akan digunakan adalah krukal wallis. Hasil dari analisis kruskal wallis akan melihat nilai bermakna atau signifikan bermakna, didapatkan bahwa konsentrasi 10 mg/l; 12,5 mg/l; 15 mg/l, dimana pada konsentrasi ini daya tetas telur terhambat dan analisis probit menunjukkan bahwa daya hambat terhadap penetasan telur 50% pada konsentrasi kaporit 1,3880 mg/l. Berdasarkan hasil tersebut kaporit dapat digunakan sebagai alternative pengendalian vector demam berdarah.

Kata kunci: Kaporit, dayatetastelur, *Aedesaegypti.*

Abstrak

Aedesaegypti is a mosquito carrying the serotypic virus DEN-1, DEN-2, DEN-3, DEN-4, where all these serotypes can cause Dengue Fever (Lestari, 2007). The aim of the study was to analyze the evaluation of chlorine concentration on the hatchability of Aedesaegypti eggs. The results showed the effect of various chlorine doses on the percentage of hatching of Aedesaegypti eggs. The higher the concentration of chlorine there is a slight increase in the number of eggs that hatch. this study is an experimental study with a post-test only group design study with various chlorine concentrations of 0 mg / l; 2 mg / l; 4 mg / l; 8 mg / l and 10.0 mg / l; 12.5 mg / l; 15 mg / l. The experimental data will be analyzed statistically, namely normality test, kruskalwallis test and probit analysis LC50. The results of the normalization test obtained a value of P <0.05, which means the value is not normal. Because the value of p is not normally distributed, the next test to be used is the crutch wallis. The results of the analysis of kruskalwallis will see significant or significant values of contributions, obtained concentrations of 10 mg / l; 12.5 mg / l; 15 mg / l, while at this concentration the hatchability of eggs is inhibited and probit analysis shows the inhibitory power of 50% egg hatching at chlorine concentration of 1.3880 mg / l. Based on these results chlorine can be used as an alternative to dengue fever vector control.

Keywords: Chlorine, egg hatchability, *Aedesaegypti.*

Preliminary

Hemorrhagic fever is characterized by sudden fever, headaches, back pain of the eyeball, nausea and manifestations of bleeding such as bleeding and bleeding on the surface of the body in patients. In general, DHF sufferers (Dengue Hemorrhagic Fever) will experience a fever phase for 2-7 days, the first phase: 1-3 days the patient will experience a fever that is quite high 40°C, then in the second phase the patient experiences a critical phase on day 4 -5, in this phase the patient will experience a fever down to 37°C. Furthermore, the third phase on day 6-7 occurs, in this phase the patient will feel fever again. This phase is called the recovery phase (Ministry of Health, 2018).

The data obtained shows that DHF is one of the extraordinary events that occurred in several regions of Indonesia. In 2009-2010 the incidence of this disease increased by around 43% or the incidence rate reached 5,556 (Dinkes, 2010). At present there is not only an increase in the number of dengue cases, but spread outside the tropics and subtropics. In 2012 there were more than 2,000 dengue cases in more than 10 countries in Europe. At least 500,000 DHF sufferers require hospitalization each year, where the proportion of events is mostly experienced by children and 2.5% and among them are reported to have died (WHO, 2014)

Dengue Fever is transmitted by vectors Aedesaegypti and Aedesalbocpictus. In the spread and transmission of this disease Aedesaegypti dominates more spread in and outside the home, whereas Aedesalbocpictus is found in many plantation areas (Yudhastuti et al., 2005)

Aedesaegypti is a mosquito carrying the serotypic virus DEN-1, DEN-2, DEN-3, DEN-4, where all these serotypes can cause Dengue Fever (Lestari, 2007). Aedesaegypti undergoes perfect metamorphosis, namely eggs, larvae, cocoons that are smoked in water (aquatic), while mosquitoes will live terestistial (free life). Female Aedesaegypti mosquitoes can produce as many as 100 eggs and are black. The egg phase will occur 2 days, pupa phase 2-4, larva phase 6-8 days, aquatics last for 8-12. Aedesaegypti mosquitoes survive 2-3 months (Ridad et al, 1999). The activity and metabolism of Aedesspp mosquitoes is directly affected by environmental factors, namely: temperature, air humidity, breeding sites, and rainfall. Aedes mosquitoes require an average rainfall of more than 500 mm per year with a room temperature of 32-34°C and a water temperature of 25-30°C, a water pH of around 7 and air humidity of around 70%. The success of the development of Aedesspp mosquitoes is determined by breeding places which are limited by annual temperatures and seasonal changes. Aedesspp mosquitoes will not be able to survive or die when pH $\leq$ 3 and $\geq$ 12 (Hariono, 2011). This mosquito species is found throughout Indonesia, living optimally at altitudes above 1000 above sea level, but from several reports it can be found in areas up to 1,500 meters high, even in India it can be found at an altitude of 2,121 meters and in Colombia at 2,200 meters (Aryu, 2010).

Handling of DHF vectors is done in various ways, one of them is using chemicals in the form of chlorine. Chlorine is a chemical commonly used to purify water. The chemical content in water also affects the hatchability of the eggs of Aedesaegypti, a study found that chlorine in water media can disrupt the development and hatching of eggs because chlorine in chlorine is able to oxidize (burn) eggs of Aedesaegypti by damaging the proteins contained in eggs. There are factors that influence the hatching of Aedesaegypti eggs. The factors that influence it include pH, temperature, humidity, light, oxygen content and chemicals in water (Bina, 2015).

Based on the previous research on the hatchability of eggs of Aedesaegypti mosquitoes, vector control using chlorine can inhibit the hatchability of eggs. And there is a difference in hatchability based on the given concentration of 2.5 mg / l; 5.0 mg / l; 7.5 mg / l and 10.0 mg / l. The results showed that the higher the concentration of chlorine in the water, the lower the hatchability of the eggs of Aedesaegypti. Chlorine inhibitory power against egg hatching is 50% at the concentration of 2.759 mg / l (Bina, 2015)

This study needs to be done to determine the concentration of chlorine which effectively kills the eggs of Aedesaegypti mosquitoes. So that later the use of chlorine as a vector control does not interfere with health, the environment and the ecosystem

Method

The materials and tools in this study are well water, eggs of Aedesaegypti mosquito, glass cup, chlorine, thermohygrometer, water thermometer, litmus paper.

This research is a quasi experimental study with a post test only design. The hypothesis of this study is whether or not there is an effect of chlorine concentration on the hatchability of the eggs of Aedesaegypti mosquitoes. The subject of this research is well water which has been given chlorine which is 1 mg / l; 2 mg / l; 4 mg / l; 8 mg / l; 10 mg / l; 12.5 mg / l; 15 mg / l and control 0 mg / l. Observation of the average number of hatching eggs of mosquitoes by giving chlorine at various levels of concentration was carried out every 24 hours of the observation period. The population in this study was Aedesaegypti eggs obtained from the Research and Development Program for the Eradication of Animal Sources (P2B2) Baturaja, South Sumatra.

The sample size in this study was 680 eggs and 4 x repetitions. Each group will put 20 eggs. The water used in this study is well water that is not physically polluted, which is odorless, colorless, tasteless, and not cloudy.

1 liter of water is put in a plastic bottle and labeled K. As much as 1 mg of chlorine is dissolved in 1 liter of water. Then the solution is put into a plastic bottle and labeled B. A total of 2 mg of chlorine is dissolved in 1 liter of water. Then the solution is put in a plastic bottle and labeled C. A total of 4 mg of chlorine is dissolved in 1 liter of water. Then the solution is put into a plastic bottle and labeled D. A total of 8 mg of chlorine is dissolved in 1 liter of water. Then the solution is put into a plastic bottle and labeled E. A total of 10 mg of chlorine is dissolved in 1 liter of water. Then the solution is put into a plastic bottle and labeled F. A total of 12.5 mg of chlorine is dissolved in 1 liter of water. Then the solution is put into a plastic bottle and labeled G. A total of 15 mg of chlorine is dissolved in 1 liter of water. Then the solution is put into a plastic bottle and labeled G. Prepare 32 clear plastic cups. A total of 4 cups of plastic are filled with well water and labeled K1, K2, K3, K4. As many as 4 cups of plastic are filled with 1 mg / l chlorine solution and are labeled A1, A2, A3, A4. A total of 4 cups of plastic filled with chlorine solution 2 mg / l and labeled B1, B2, B3, B4. As many as 4 cups of plastic are filled with 4 mg / l chlorine solution and are labeled C1, C2, C3, C4.A total of 4 cups of plastic filled with chlorine solution 8 mg / l and labeled D1, D2, D3, D4. A total of 4 cups of plastic filled with chlorine solution 10 mg / l and labeled E1, E2, E3, E4. As many as 4 cups of plastic are filled with chlorine solution 12.5 mg / l and labeled F1, F2, F3, F4. 4 cups of plastic are filled with 15 mg / l

chlorine solution and are labeled G1, G2, G3, G4. Then in each group 20 eggs were filled. Every 24 hours an observation will be made and the results of observations will be recorded in 9 days. pH measurements were carried out on the first day only, measurements of temperature and humidity in the room were carried out until the 9th day. The data obtained will be analyzed descriptively to calculate the hatchability of the eggs, namely the percentage of hatchability of the eggs. Shrinked by analysis of kruskalwallis to determine the level of relationship between chlorine and hatchability of eggs and probit analysis of LC50 to determine the concentration of 50 was effective in inhibiting hatchability of eggs.

Results

Measurement of room temperature, humidity and water temperature were carried out at the time of observation for 9 days. Based on the results of observations that have been made obtained a minimum temperature of 23.6°C and a maximum temperature of 32.1°C.While the humidity of the room during the study obtained a minimum humidity of 50% and a maximum of 83%. For the temperature of the water obtained a minimum of 26 °C and a maximum of 30 °C. Measurement of concentration pH using pH litmus paper was carried out before the eggs were inserted and the observations made were based on high and low concentrations of acid Ph obtained at concentrations of 15 mg / l and 12.5 mg / L while the neutral Ph was obtained at concentrations of 0 mg / L and 1 mg / L. Effect of 0 mg / L chlorine concentration; 1 mg / L; 2 mg / L; 4 mg / L; 8 mg / L; 10 mg / L; 12.5 mg / L; 15 mg / L against the hatchability of the eggs of Aedesaegypti mosquito was obtained by the number of eggs hatching differently in each concentration.

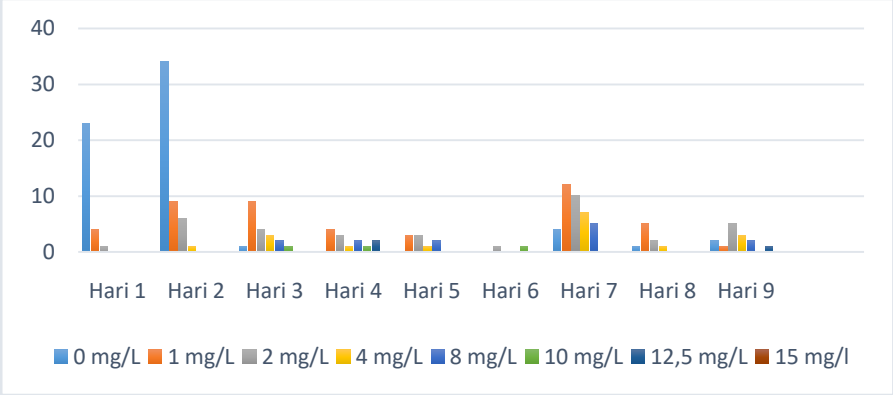

Figure 1. Average percentage of eggs hatched at each concentration for 9 days
In the picture above shows that the higher the concentration of chlorine, there is a tendency for the time needed for eggs to hatch longer.

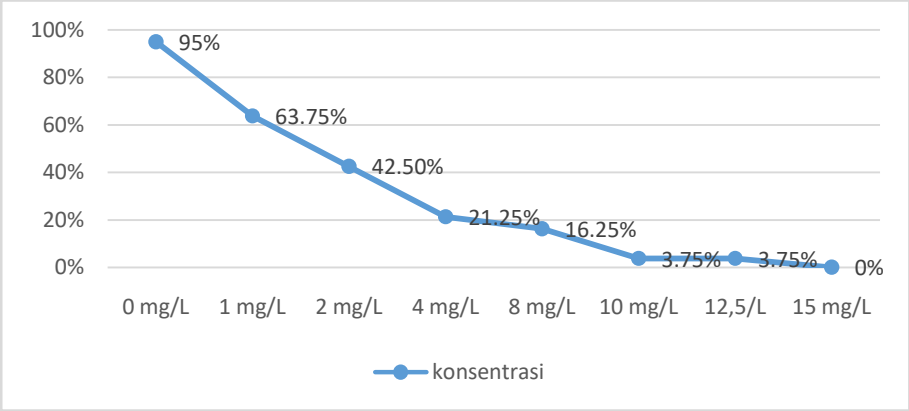

Figure 2. Percentage of hatchability of eggs of Aedesaegypti at various concentrations of chlorine

Data Analysis Results of Variance Analysis

Amount of eggs Ae.aegypti which hatches at various levels of chlorine concentration (0 mg / l; 1 mg / l; 2 mg / l; 4 mg / l; 8 mg / l; 10 mg / l; 12 mg / l; 12 mg / l; 15 mg / l)) for 9 days based on the normality test with Shapiro Wilks at α = 5%, the concentration variable was 0 mg / l; 15 mg / l p value> 0.05 normal while concentration of 1 mg / l; 2 mg / l; 4 mg / l; 8 mg / l; 10 mg / l; 12.5 mg / l p value <0.05 indicates abnormal data. Therefore, the statistical analysis used was no longer one way ANOVA but the Kruskal Wallis Test, there were differences in the number of eggs hatched at various concentrations of chlorine

Probit Analysis Results

The amount of chlorine concentration can inhibit the hatchability of Ae eggs. 50% of aegypti is 1.338 mg / l. A total of 1,338 mg / l chlorine in 1 liter of water is effective in killing mosquito eggs. In this concentration the threshold value of chlorine consumption is still normal.

Discussion

Temperature, temperature and pH of the water greatly affect the breeding of mosquito eggs. Based on the measurements and observations that have been made, the lowest room temperature obtained is 23.6°C and the highest is 32.1°C. For the water temperature, the lowest temperature is 26 °C and the highest temperature is 30 °C. pH of chlorine solution 0 mg / l and 1 mg / l which is pH 7 yag means neutral, chlorine solution 2 mg / l; 4 mg / l; 8 mg / l; 10 mg / l which is pH 6 is acidic while chlorine solution is 12.5 mg / l; 15 mg / l which is pH 5 is acidic. The temperature room was also measured where the lowest moisture content was 50% and the highest was 83%. The optimum temperature for mosquito growth is 25-27°C and growth will stop altogether if the temperature is less than 10°C or more than 40°C (Yotopranoto, 1998). Aedesaegypti eggs can last for months at a temperature of 2-4°C and will hatch at 23-27°C if in water (Yulidar, 2014). The optimal degree

of acidity (pH) that results in the highest hatchability of eggs is pH 7.21 while for the survival of maximal larvae at pH 8 and high humidity will increase egg hatching (DwiAstuti, 2018). The optimal level of water pH produces highest egg hatchability is pH 7.21 while maximal larval survival at pH 8 (DwiAstuti, 2018). In addition, the egg storage time also affects the hatchability of eggs. There are also indications that the length of time the egg is drying has an impact on the length of time the egg hatches. The faster the eggs are hatched, the more larvae are produced because the eggs are still in good condition and fresh. Low temperature and humidity can cause metabolism to slow down, thus affecting the development and hatchability of eggs. Research shows that the temperature of the media used for hatching, the time / age of the eggs being hatched, the storage of eggs before hatching affect the hatchability of eggs.

Based on the research, it was found that Ae eggs. aegypti in well water without the addition of chlorine hatched on observation day 28.75%, while at a concentration of 1 mg / L the eggs hatched 5%, 2 mg / L eggs hatched 1.25% while the concentration of 4 mg / L; 8 mg / L; 10 mg / L; 12.5 mg / L; 15 mg / L no eggs hatch. The highest hatching occurred on day 2 at a concentration of 0 mg / L where the percentage of egg hatching was 42.50%. the lowest hatching was found at a concentration of 15 mg / l where the results obtained for 9 days no eggs hatched.

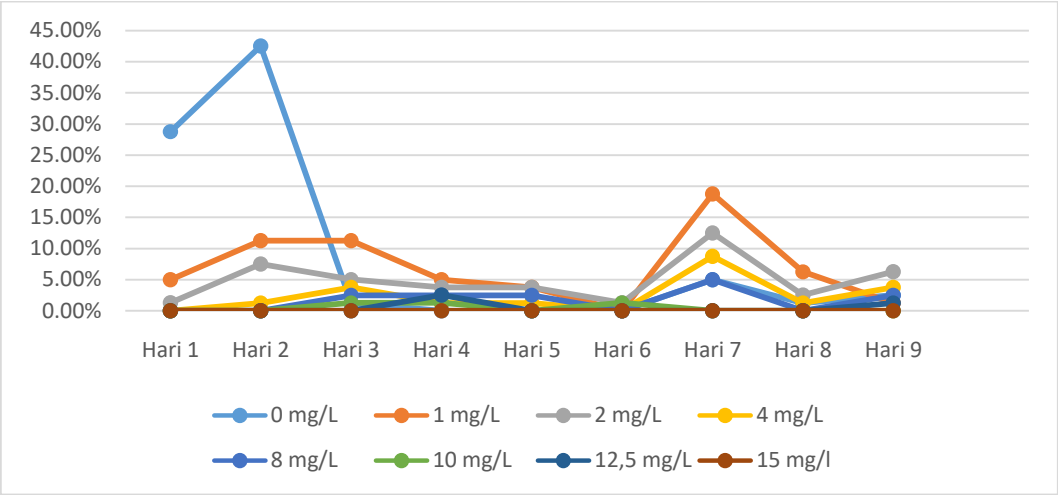

Figure 3. Percentage of eggs hatching graph

Data obtained for 9 will be analyzed to determine the relationship of chlorine with the hatchability of the eggs of Aedesaegypti mosquitoes. The analysis used in the form of univariate analysis to determine the normality of the data, if the data is normal or ($p < 0.05$) bivariate analysis used one way ANOVA if it is not distributed or ($p > 0.05$) then it will use the CrissWalliss. Bivariate analysis to determine the relationship

between chlorine and hatchability and probit analysis to find out the LC50 on chlorine. The univariate analysis used was kruskalwalliss, indicating a significant difference between treatment groups. To find out the most significantly different groups, a post-hoc test was conducted. After 9 days of treatment, chlorine groups with a concentration of 10 mg / L, 12.5 mg / L and 15 mg / L had a significant difference ($p < 0.05$) with a concentration group of 0 mg / L in the hatchability of Aedesaegypti eggs. . Thus, chlorine with a concentration of 10 mg / L, 12.5 mg / L and 15 mg / L can inhibit the hatching of mosquito eggs compared to controls.

Knowing that there is a correlation between chlorine and the hatchability of eggs of Aedesaegypti mosquitoes, it is necessary to do a probit analysis whose function is to know LC50 on chlorine. The results of the probit analysis showed that at chlorine concentration of 1.3880 mg / l it could inhibit 50% hatching of eggs where concentration was still within normal limits for human health and the environment. The use of chlorine as a disinfectant has a safe concentration limit for humans. This shows that if there is an excess dose of chlorine affixing it will affect the taste and smell of water and other effects on the human body. Whereas according to the World Health Organization (WHO) the residual threshold value of safe use of chlorine in water is 5 ppm or 5 mg / l (Suryaningrum, et al., 2007).

Conclusion

From the research conducted in FK UnsriMadanglaboratory in the month of November 28-December 6 2018 for 9 days, it was concluded that the higher the concentration of chlorine in the water, the lower the hatchability of the eggs of Aedesaegypti. Chlorine inhibitory power against egg hatching by 50% at 1.3880 mg / l concentration.

Suggestion

The program (Health Office) can utilize chlorine as an inhibitor of the hatching of Aedesaegypti mosquitoes for effective control of dengue fever vectors. The community can independently use chlorine to inhibit the hatching of Aedesaegypti eggs at a water reservoir at home. Further research is needed by using Aedesaegypti eggs that meet the standard time of storage for research so that research results will be obtained as expected

BIBLIOGRAPHY

Aryucandra, 2010.*DemamBerdarah Dengue: Epidemiologi, Patogenesis Dan FaktorResikoPenulara*. Aspiratori Vol.2 No.2 tahun 2010.

BinaIkawati, Reza AyuRizqiMeilani, 2015.*Pengaruh KonsentrasiKaporitTerhadap DayaTetasTelurAedesAegypti,* Jawa Tengah.Vol.7 No.2 tahun 2010.

Dinkes, 2010.*Profilkesehatantahun 2010*, Semarang.

DwiAstuti, 2018. Pengaruh pH Air TerhadapDayaTetasTelurdan Sintasan Larva NilaMerah

(Oreochromis sp.) Strain NilasaYunita. Program StudiS1 BudidayaPerikananUniversitasGadjahMada, 2018.Yogyakarta.

HariyonoP.*Ujibakteriologis air sumur di KecamatanSemampir Surabaya* [Skripsi]. Surabaya: FakultasSains Dan TeknologiUniversitasAirlangga; 2011.

Kemenkes RI, 2018. KemenkesOptimalkan PNS Cegah DBD tahun 2017, Jakarta.

Lestari K. *Epidemiologi Dan PencegahanDemamBerdarah Dengue (DBD) Di Indonesia*.Farmaka.Desember 2007; Vol. 5 No. 3, Desember 2007.

Ridad A, H. Ochadian, D.Natadisastra. 1999. *BungarampaiEntomologiMedik*. Edisi ke-2.BagianParasitologi FK Unpad.

Suryaningrum, Riana Dyah, dkk. 2007.*Peningkatan Kadar TanindanPenurunan Kadar Klorin*. JurusanPendidikanBiologi, FKIP, Universitas Malang.

WHO, 2014.Dengnue and severe dengue, from wordl health organization.http://www.who.int/mediacentre/factsheets/fs117/en/.

Yudhastuti R, Vidiyani A. *HubunganKondisiLingkungan, Kontainer, danPerilakuMasyarakatdenganKeberadaanJentikNyamuk Aedesaegypti di Daerah EndemisDemamBerdarah Dengue Surabaya*. JurnalKesehatanLingkungan. 2005;1.

Yotopranoto, S., Sri Subekti, Rosmanida, Sulaiman. (1998).DinamikaPopulasiVektorpadaLokasidenganKasus DemamBerdarah Dengue yang Tinggi di KotamadyaSurabaya.Majalah KedokteranTropisIndonesia. Vol9 : No. 1-2.

Yulidar, 2014.PengaruhPemaparanberbagaikonsentrasitemefospadalarva instar 3 (L3) terhadapmorfologitelur*Aedes aegypti*. JurnalVektorPenyakit. 2014; 8(2):41–4.