Susceptibility status of Aedes aegypti, Aedes albopictus, Culex quinquefasciatus and Anopheles subpictus to insecticide cypermethrin

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Abstract. **Objective:** This study aims to determine the susceptibility status of Aedes aegypti, Aedes albopictus, Culex quinquefasciatus and Anopheles subpictus to insecticides Cypermethrin 0.05% in Makassar City. **Methods:** The samples were adult females of mosquitoes aged 3-5 days. They were tested with exposure of Cypermethrin 0.05% and one control with three replication. The number of samples per test treatment and control was 20. The data were analyzed by looking at the mortality percentage of each treatment to determine differences in susceptibility status to Cypermethrin 0.05%. The analysis also involved a probit test on a Minitab application to view the LT₅₀, LT₉₀, LT₉₅, LT₉₉. **Results:** Showed that the mortality rate of Aedes aegypti was 53.3% with a resistant status, while the result for Aedes albopictus and Culex quinquefasciatus were 85% and 81.7% respectively with a tolerant status. Anopheles subpictus was still susceptible with a mortality rate of 100%. The LT₉₉ values is 3635.75; 1664.65; 2070.2; 106.9. **Conclusion:** Susceptibility of Aedes aegypti mosquito, Aedes albopictus, Culex quinquefasciatus, Anopheles subpictus have variations in susceptibility. Value lethal time showed that the insecticide Cypermethrin 0.05% takes a long time to kill mosquito.

1. Introduction

Vector borne disease is a disease that is transmitted through animal intermediaries (vectors) disease. Vector borne diseases include malaria, arbovirosis such as Dengue, Chikungunya, Japanese B Encephalitis (inflammation of the brain), lymphatic filariasis (elephantiasis), pes (pestilence) and bush fever (scrub typhus). The disease until now is a public health problem in Indonesia with high morbidity and mortality rates and the potential to cause extraordinary events (KLB)[1].

DHF is a disease spread by the Aedes aegypti and / or Aedes albopictus mosquito vectors whose spread is increasingly widespread, this is seen by the case in almost all regions in Indonesia. Based on data from the Ministry of Health of the Republic of Indonesia, the number of DHF sufferers reported in 2017 was 68,407 cases with 493 deaths (IR = 78.85 per 100,000 population and CFR 0.72%), with infected areas reaching 10 provinces. Likewise filariasis transmitted by Culex mosquitoes sp., In the same year, there were 12 677 cases. Whereas for malaria cases transmitted by Anopheles sp. API
Vector borne disease control, in addition to the treatment of patients, also performed with the vector control efforts to prevent contact with the vector, in order to prevent the transmission of disease, vector control can be done by controlling the biological, physical, or chemical [3].

Along with the development of science and technology, insecticides continue to develop over time, more and more considerations in insecticide formulations, especially safer for the environment. Resistance to organophosphate insecticides causes the use of insecticides to switch to pyrethroid groups. Pyrethroids are used as a substitute for the effect that directly works on the insect nervous system so that the effectiveness is even higher. In addition, synthetic pyrethroid insecticide classes are also more environmentally friendly than the class of organophosphate insecticide[4]. The effectiveness of this insecticide was proven in the study that Aedes aegypti mosquitoes in Makassar City and Barru District were susceptible to cypermethrin (cyf 50 EC) 1.5%[5].

Based on the above background, it is considered very important to conduct research on the susceptibility status of Aedes aegypti, Aedes albopictus, Culex quinquefasciatus and Anopheles subpictus against Cypermethrin insecticide, this is done as a basis for selecting insecticides in eradicating the vector in Makassar City that is effective, efficient and appropriate.

2. Method
This research is an experimental research design with "Post test only control group design". This research uses the Susceptibility Test method including WHO standard impregnated paper. The population of this study were Aedes aegypti, Aedes albopictus, Culex quinquefasciatus, and Anopheles subpictus female mosquitoes as a result of pre-adult breeding obtained from research sites that inherited the nature of the mother's resistance and breed in the laboratory. The samples of this study were 20 population members taken randomly from Aedes aegypti, Aedes albopictus, Culex quinquefasciatus, and Anopheles subpictus females for each observation unit. Overall sample size is 480 mosquitoes that for every observation there is one species of mosquito which consists of a control group of 20 mosquitoes, treatment with insecticide exposure Cypermethrin 0.05% 20 mosquitoes. The treatment was replicated 3 times so that the total mosquitoes needed for each species were 120 mosquitoes. The percentage of mosquitoes die after holding a 24-hour count. Susceptibility criteria are determined according to WHO at 98-100% = (sensitive), 80-97% = (verification / tolerance required), <80% = (resistant)[6]. The observation of the percentage of treated mosquito mortality by probit analysis to see the effect of the lethal time after contact insecticide Cypermethrin 0.05%.

3. Result
The results showed that the susceptibility status of mosquitoes to insecticide exposure Cypermethrin 0.05% indicates that mortality rates varied, as shown in figure 1, where for Aedes aegypti mosquitoes have experienced resistance with a mortality rate of 53.3%. As for mortality Aedes albopictus mosquito, and Culex quinquefasciatus has been tolerant with each percentage mortality of 85% and 81.7%. As for the Anopheles subpictus mosquito the mortality rate is 100% with a susceptibility status. The LT99 values of Aedes aegypti, Aedes albopictus, Culex quinquefasciatus, and Anopheles subpictus on the exposure of 0.05% Cypermethrin insecticide respectively 3635.75; 1664.65; 2070.2; 106.9.
4. Discussion

Based on the results of the study it can be said that the application of Cypermethrin 0.05% is only effective for controlling Anopheles subpictus mosquitoes, whereas for Aedes albopictus mosquitoes, and Culex quinquefasciatus it is still necessary to re-verify both the concentration and dose in its application. As for the Aedes aegypti mosquitoes, they show resistance status, so alternative insecticides are needed in the control process. Susceptibility status of mosquitoes in this study are consistent with research conducted by Ikawati (2015), in Central Java, which showed that the mosquito Aedes aegypti in all research areas almost all resistant to the insecticide Cypermethrin 0.05% just a sample of Banjarnegara still tolerant to insecticides Cypermethrin 0.05%[7]. Meanwhile, in a study conducted by Susanti et al (2012), it was explained that the insecticide made from Cypermethrin which was applied by fumigation (thermal fogging), was effectively used to kill mosquitoes vector Anopheles sp inside and outside the home with a mortality rate of 100%[8].

The resistance of the Aedes aegypti mosquito can occur as a result of the continuous use of insecticides carried out by the community, because some mosquito spray drugs on the market contain insecticides made from Cypermethrin. Cypermethrin is a contact and stomach poison compounds whose use is very extensive. In addition to a number of insect control products on the market, public concern over contracting the dengue disease, Malaria and Filariasis caused their household insecticide use excessively.

In this study it was also found that the Aedes albopictus and Culex quinquefasciatus mosquitoes were tolerant of 0.05% Cypermethrin insecticide. This mosquito susceptibility status can be caused by the location of its rest which tends to be less exposed to household insecticides that are commonly used so that they are still tolerant of these insecticides. In Sri Lanka it was reported that mosquitoes Aedes albopictus and Culex sp are susceptible to exposure to insecticides which are often used because these mosquitoes tend not to rest indoors like on walls. The mosquitoes mostly breed in tree holes and small bodies of water that are difficult to reach by insecticide sprays[9].

The susceptibility of mosquitoes is also much influenced by factors related to the mosquito bionomic nature. As in Anopheles subpictus mosquitoes which have breeding sites around the coast where the water characteristics are brackish or lagoon water. In this area of research is rarely found their plantation where on the activity generally use an insecticide as an insect or pest control. Condition of the area around the site is a pond area which tends to rarely use pesticides in particular

**Figure 1.** Percentage of Mortality Aedes aegypti mosquito, Aedes albopictus, Culex quinquefasciatus and Anopheles subpictus on the exposure Insecticide Cypermethrin 0.05%.
the active ingredients Cypermethrin. Total exposure to insecticides bit allows anopheles mosquitoes subpictus in this research area are still susceptible to the insecticide Cypermethrin 0.05%. Where Georgiou in Asriani (2015), suggested that one of the factors that influence the rate of resistance is where an insect population that receives greater pressure will develop into a resistant population than a population that receives a weak pressure. This pressure can come from the concentration or frequency of an insecticide[10].

In this study, although it was found that the susceptible Anopheles subpictus and Aedes albopictus and Culex quinquefasciatus were tolerant of Cypermethrin 0.05%, control efforts especially those related to the application of this insecticide need to be considered because the lethal time (LT99) values obtained were classified as numbers that are high. According to observations of the difference in lethal time values between mosquito species in this study the higher along with the level of resistance of mosquitoes to insecticides where the highest lethal time value is in Aedes aegypti mosquitoes. Besides being caused by insecticide pressure that is often used, other factors that trigger the level of resistance based on experiments conducted by Lagunes (1980), namely Culex quinquefasciatus mosquitoes have genes that are resistant to three types of insecticides namely Temefos, Propuksur and Permethrin. One of the three types of insecticides is pyrethroid insecticide which allows cross resistance between insecticides[11].

The results showed that all the mosquitoes are prone to have a value high enough lethal time on exposure to the insecticide Cypermethrin 0.05%, it is necessary there is a strategy to apply in the field so that when the application is attempted lasts longer contact between the mosquito insecticide targets, so that all mosquitoes can be killed, if not then the surviving mosquitoes will develop into resistant mosquitoes and continue the filial nature in the next generation.

5. Conclusions
The conclusions of this study are Aedes aegypti, Aedes albopictus, Culex quinquefasciatus, and Anopheles subpictus mosquitoes in the applicant of Cypermethrin 0.05% the vulnerability of mosquitoes varies that is, for Aedes aegypti mosquitoes that have been resistant whereas Aedes albopictus, and Culex quinquefasciatus tend to be tolerant, except for Anopheles subpictus which is still susceptible. The lethal time value representing the Cypermethrin 0.05% insecticide was obtained quite high, this means that the 0.05% Cypermethrin insecticide needed a long time to replace mosquitoes. Comment on Expenditure Policy for vectors in Makassar City. In addition, the use of controlling insecticides commonly used by the people is used as needed to accelerate the increase in resistance to mosquitoes.

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