

EFFECTIVENESS OF DIFFERENT DETERGENT SOLUTIONS AS LARVICIDE FOR *AEDESAEGYPTI* LARVAE

I Made Sudarmaja, I Kadek Swastika

Departement of Parasitology, Faculty of Medicine Udayana University, Bali-Indonesia

Background: Dengue hemorrhagic fever the spread of which is mediated by *Aedes aegypti* mosquito that becomes a health problem in Indonesia every year. Some natural and chemical substances had been experimented to combat *Aedes aegypti*, one of them is detergent solution. This study aims to investigate the effect of several concentrations of detergent to kill *Aedes aegypti* larvae, and to find out the lethal concentration (LC)₅₀, LC₉₀, and LC₉₅. **Method:** Randomized posttest only control group design was applied to observe the percentage of *Aedes aegypti* larvae instar III-IV killed when they contacted to various detergent concentrations within 24 hour of observation. **Results:** This study result showed that detergent with the concentration of 0.12 g/l; 0.14 g/l; 0.16 g/l; 0.18 g/l; 0.20 g/l; 0.22 g/l and 0.24 g/l respectively showed the killing of *Aedes aegypti* larvae 37.6%, 42.4%, 74.4%, 85.6%, 89.6%, 95.2% and 100%, respectively. Probit analysis showed that LC₅₀ = 0.14 gram/liter, LC₉₀ = 0.20 g/l and LC₉₅=0.22 g/l.

Key words: *Aedes aegypti*; detergent; solution

INTRODUCTION

Dengue hemorrhagic fever (DHF) is a disease caused by virus infection which is spread by mosquito. The fastest spreading in the world is indicated by incidences that tend to increase every year. It was predicted that about 50 to 100 million cases of new infection emerge every year and about 2 to 5 billion citizens who live in endemic countries that have high risk are infected.^{1,2} The species of mosquito that plays the main role as DHF vector in Southeast Asia is *Aedes aegypti*.³

Because the specific medicine and vaccine for DHF has not yet been founded, the prevention of DHF is aimed to control the vector.² *Aedes aegypti* is known to prefer breeding places mainly in man-made containers with clear water inside such as rainwater.^{4,5} In order to control *Aedes aegypti*, people should clean, close and bury those man made containers.^{6,7} Bali as the world's tourism destination is one of Indonesian provinces with high incidence rate of DHF within above national rate.^{8,9} For supporting tourism, Bali produces a lot of artworks and handicrafts, such as basins made from stone and big pots that can become breeding place of *Aedes aegypti* in the rainy season. Those artworks and handicrafts that contain water are difficult to clean and empty because they are usually deep and if covered, it will decrease the value of art and purchase. In this case, safe larvicide was needed that is available for people. Some natural and chemical substances have been experimented to combat larvae of *Aedes aegypti*, one of them is detergent solution.

Detergent is one of cleansing agents used in households that is available and has the potential as larvicide for *Aedes aegypti*. Some studies showed that detergent could prevent oviposition and killed the larvae of *Aedes aegypti* in various concentrations.¹⁰⁻¹² However, water that contains detergent can still be used as breeding place of *Aedes aegypti*.¹³ This study was carried out in order to find the lethal concentration (LC) of detergent solution for killing of *Aedes aegypti* larvae.

MATERIALS AND METHODS

This study applied *randomized post test only control group design* with one control group versus seven treatment groups, while the selection and inputting of samples were carried out randomly. Control group was a container which contained well water while treatment groups were containers which contained well water plus detergent with concentration of 0.12, 0.14, 0.16, 0.18, 0.20, 0.22 and 0.24 g/l. Every group was replicated 5 times and each container filled with 25 larvae of *Aedes aegypti* instar III – IV according to WHO standard.¹⁴

RESULTS

After 24 hours observation, the *Aedes aegypti* larvae in all treatment groups were dead but not in the control group. The average percentage of the larva's death in the treatment groups can be monitored in Table 1.

Probit analysis was carried out to determine the ability of detergent water as *Aedes aegypti* larvicide, to get the exact detergent concentration that can kill 50% larva (LC₅₀), 90% larva (LC₉₀) and 95% larva (LC₉₅). The result of the probit analysis can be observed in Table 2:

Address of Correspondence: I M Sudarmaja
Department of Parasitology Faculty of Medicine
Udayana University, Bali-Indonesia
Email: msudarmaja@gmail.com

Table 1
The average percentage of the *Aedes aegypti* larva's death in several detergent concentrations during 24 hours observation

Concentration (gr/liter)	Percentage of larva's death					Average percentage of larva's death
	I	II	III	IV	V	
0.12	32	40	44	36	36	37.6
0.14	32	40	40	60	40	42.4
0.16	76	72	80	68	76	74.4
0.18	92	84	84	88	80	85.6
0.20	92	84	86	92	84	89.6
0.22	100	84	100	96	92	95.2
0.24	100	100	100	100	100	100

Table.2
The Percentage of larva's death, LC₅₀, LC₉₀ and LC₉₅ value of the detergent solution on the *Aedes aegypti* larva

Detergent Concentration (gr/liter)	Larva's death Percentage (%)	LC ₅₀ (gr/lt) (CI 95%)	LC ₉₀ (gr/lt) (CI 95%)	LC ₉₅ (gr/lt) (CI 95%)
0.12	37.60	0.14 (0.13-0.14)	0.20 (0.19-0.21)	0.22 (0.20-0.23)
0.14	42.40			
0.16	74.40			
0.18	85.60			
0.20	89.60			
0.22	95.20			
0.24	100.00			
Control	0.00			

DISCUSSION

Table 1 shows that detergent has the potential as larvicide on *Aedes aegypti* mosquito. Higher concentration increases the larvicide capability. At 0.24 g/l concentration, all of the larvae were destroyed (100%). With the one-way anova statistic test, the result was $p < 0.05$ which means that there was significant difference from the average *Aedes aegypti* larvae death in the study groups. The post hoc LSD test showed that the significant difference existed in all treatment groups and also in the control group. This result showed that higher detergent concentration in a container killed more larvae, up to 0.24 g/l concentration. Some previous researches also support this result. Water with higher detergent concentration, 1.5 g/l, even is not chosen by the *Aedes aegypti* mosquito as its oviposition place.¹² Beside not being chosen as oviposition place, at 1.5 g/l detergent concentration, until the seventh day, none of the *Aedes aegypti* eggs hatched.¹¹ Prasantong also found similar result, where some detergent brands were able to prevent oviposition and killed the *Aedes aegypti* larvae. The Fab detergent brand in 0.07% concentration could prevent oviposition of *Aedes aegypti* until 22 days.¹⁰

Lethal concentration of detergent solution that can kill 50% larvae (LC₅₀) in this study were 0.14 g/l (CI 95% = 0.13-0.14). This was far less than that found in the study by Prasantong in Thailand who got result at 0.07% or 0.7 g/l in the Fab brand detergent. The study in Thailand also found LC₅₀ result that was nearly the same with this study, which was obtained with different detergent brand, Breeze, that was 0.02 % (0.17 g/l), and Paic brand 0.02% or 0.19 g/l.¹⁰ The probit analysis also obtained lethal concentration that can kill 90% larvae (LC₉₀) at 0.19 concentration (CI 85% = 0.19-0.21) and lethal concentration that could kill 95% larvae (LC₉₅) at 0.22 g/l concentration (CI 95% = 0.20-0.23). LC₉₀ in this study showed similar result with the LC₅₀ of the study by Prasantong with Paic brand solution.¹⁰

Detergent has larvicide potential because it contains surfactants, which consist of non-ionic surfactant, ionic surfactant and cationic surfactant. Surfactant has amphiphilic structure that consists of two parts, namely the ionic cluster and the hydrocarbon cluster. The ionic cluster has strong affinity to water, while the hydrocarbon cluster has not.¹⁵ The surfactants contained in water will obstruct the oxygen supply at the water surface and kill the larvae.¹³

CONCLUSIONS

Detergent has potential as larvicide for the *Aedes aegypti* larvae. Detergent solution with 0.12, 0.14, 0.16, 0.18, 0.20, 0.22 and 0.24 g/l concentration is able to kill *Aedes aegypti* larvae as high as 37.2%, 42.4%, 74.4%, 85.6%, 89.6%, 95.2% and 100%, respectively. Higher concentration of detergent was capable to kill more larvae. The statistic test showed that the average percentage of the death of *Aedes aegypti* larvae differed significantly between all the treatment groups and also with the control group. The probit analysis found that the lethal concentration that could kill 50% larvae (LC_{50}) is 0.14 g/l (CI 95% = 0.13-0.14), lethal concentration that could kill 90% larvae (LC_{90}) is 0.19 g/l (CI 85% = 0.19-0.21) and lethal concentration that could kill 95% larvae (LC_{95}) is 0.22 g/l (CI 95% = 0.20-0.23).

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