

## EFFECTIVENESS OF HSU JIA CHANG MOSQUITO TRAP MODIFICATION IN INDONESIA

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### ABSTRACT

**Background:** Mosquito trap is considered controlling *Aedes* sp. by reducing vector density without insecticides. Mosquito trap proved effective according to several laboratory studies is Jia Chang Hsu mosquito trap. The purpose of this study is to determine the effectiveness of Hsu Jia Chang mosquito trap modified by using hay infusion.

**Materials and Methods:** The study was conducted in East Purwokerto, Banyumas by placing the 1,200 mosquito traps (600 experiments and 600 controls) in 300 houses. The type of research is quasi-experimental with post-test method only. The analysis used is one-way ANOVA followed by LSD, previously normality test done by using Kolmogorov-Smirnov.

**Result:** The test results showed the index of mosquito trap in control group amounted to 22%, while the index of mosquito trap in Hsu Jia Chang modification mosquito trap is 46%. Thus, there is a different between modified and ordinary mosquito trap.

**Conclusion:** Hsu Jia Chang mosquito traps using hay infusion is more effective than water well attractants. The use of mosquito traps with hay infusion can be applied as a means to control the mosquito *Aedes* sp. in society.

**Keywords:** Hsu Jia Chang, Mosquito Trap

## 1.0 Introduction

Dengue Hemorrhagic Fever (DHF) and Chikungunya are still threats in Banyumas District that according to Banyumas District Health Office, DHF cases increase from 209 up to 226 cases in 2015 and Chikungunya disease becomes outbreak with a report of 361 cases where it is 270 cases in previous year. Most often found cases of dengue fever and Chikungunya is in II Purwokerto Timur Health Center that from 2010 to 2013, 8 cases of DHF are found and until August 2014 Chikungunya cases reach the number of 68 (Banyumas District Health Office, 2014).

Various eradication efforts have been undertaken, among others, fogging focus, selective larva siding, health education and simultaneous mobilization of mosquito breeding eradication in every sub-district (Banyumas District Health Office, 2013). However, until the end of 2014, the free larvae rate in Banyumas Regency is still low, that is 78.83% (Banyumas District Health Office, 2014). The low free larvae rate in Banyumas can also be known through the free larvae rate in health centre, one of which is II Purwokerto Timur Health Centre which has free larvae rate of 78.17%. Free larvae rate should reach at least 95% in order to support the success of the prevention program of DHF transmission (Ministry of Health Republic of Indonesia, 2010).

One of successful way to reduce *Aedes sp.* vector density without in some countries is the use of mosquito traps. Eggs trapped inside the mosquito trap can be immediately thrown away so they cannot develop into larvae or mosquitoes. Mosquito trap succeeds in reducing the number of DHF vectors because eggs and larvae are very easy to find and discard. Mosquito trap is a cheap and simple tool because its components can be made by using second-hand items easily found in every home, such as used tin, bamboo or wooden chips and water (Tanjung, 2011). In addition, mosquito traps are easy, both in cleaning and maintenance. Modified mosquito trap is done to increase the productivity of mosquito, such as by using attractant that can influence the behaviour of mosquito in choosing laying place. Modifying the mosquito trap by adding an attractant substance proves to increase the number of trapped eggs (Polson, 2002).

Various types of attractiveness in the mosquito trap have been made, among others, by using household wastewater, water immersion shrimp, water immersion shells, red chili water immersion and hay infusion. Based on some research results found that hay infusion is the most effective attractant. The hay infusion influenced *Aedes* mosquitoes in choosing a breeding site as evidenced by the number of trapped *Aedes* eggs (Polson, 2002). Modified mosquito trap with hay infusion controlled *Aedes aegypti* larva in Krapyak, Semarang City in 2012 (Purnamasari, 2012). Other studies modified various concentrations (10%, 30%, 50% and 90%) in hay infusion and the results show that straw water in the 90% concentration is most effective in inviting mosquito (Hendayani, 2007). Besides being effective as attractant the raw materials used are also quite easy and cheap to obtained given that most of Purwokerto area is agricultural land.

One type of mosquito trap modification that is successfully used is the Hsu Jia Chang mosquito trap. This method was invented by Hsu Jia-Chang, the inventor assisted by his teacher. Hsu Jia Chang (2007) mosquito trap design made of used mineral water bottles is proven effective in capturing mosquito.

Some research in the laboratory has proven that the use of mosquito trap Hsu Jia Chang effective as a mosquito trap. However, the effectiveness of the mosquito trap has not been conducted in the field. Therefore, researchers feel the need to do research on the effectiveness of mosquito trap model Hsu Jia Chang with natural-made attractant for the community.

## 2.0 Materials and Methods

The type of research used is quasi experiment posttest only with control method. The study was conducted by placing 1,200 mosquito traps (600 treatments and 600 controls) at 300 homes in Banyumas. The selected sub-districts are Kranji, Sokanegara and Purwokerto Timur. Each urban village selected 100 houses to be placed mosquito trap. The number of houses chosen in accordance with the provisions of the Entomology Survey Guideline of Department of Health, Republic of Indonesia 2013 so that the total number of homes given the treatment of 300 homes. What is meant by the treatment is that the house is located in the trap of a modified Hsu Jia Chang mosquito by using hay infusion, while the control is a house with a modified trap with well water. Each house is given four separate mosquito traps. Two mosquito traps are placed inside the house, while the other two are outside. The time span required for the installation and retrieval of the mosquito trap is ten days with observations taken every two days. After ten days, the mosquito trap was taken to the Epidemiology Laboratory of the Public Health Department, Health Sciences Faculty, Universitas Jenderal Soedirman for identification of mosquitoes (type and stage of mosquitoes) and counting the number of each trapped mosquito stage.

Analytical data using univariate analysis (frequency distribution) and bivariate analysis were conducted to examine the effect of each type of attractiveness and the location of ovitrap mounting on the ovitrap index and the number of mosquitoes trapped within the mosquito trap. Bivariate analysis with one-way ANOVA assay followed by LSD, previously tested for normality with Kolmogorov-Smirnov.

## 3.0 Result

### 3.1 Intervention

Figure 1 shows the differences of temperature, pH and colour between hay infusion water and well water.

Figure 1. Temperature, pH and color of soaking hay and well water

Water	Temperature	pH	Colour
Hay infusion	24	5	Yellow, turbid
Well (Control)	27	7	Clear, transparent

The environmental factors measured and observed in this study are temperature, color and pH of the attractiveness filled into the ovitrap. The observed results show the difference of temperature, color and pH between hay infusion and rain water.

### 3.2 Number of mosquito trapped

The number of total adult mosquito, larva and pupa between Kranji, Purwokerto Lor and Sokanegara showed in figure 2.

Figure 2. Number of mosquito trapped based on location and mosquito's stadium

Location	Number of house	Adult	Larva	Pupa	Total
Kranji	100	206 (49.3%)	1470 (33.8%)	171 (52.3%)	1847 (36.2%)
Purwokerto Lor	100	126 (30.1%)	1867 (42.9%)	85 (26.0%)	2087 (40.8%)
Sokanegara	100	86 (20.6%)	1017 (23.4%)	71 (21.7%)	1174 (23.0%)
Total	300	418 (8.2%)	4354 (85.4%)	327 (6.4%)	5099 (100%)

A hundred homes examined in each region, the largest number of mosquito populations was found in Purwokerto Lor village, which was 40.8%. Based on mosquito stage, the population of most adult and pupa mosquitoes was found in Kelurahan Kranji (49.3% and 52.3%). Number of Aedes larvae population most found in Purwokerto Lor village area (42.9%).

Figure 3. Number of mosquito trapped based on location of mosquito trap

Location	Inside House	Outside House	Total
Kranji	1098	749	1847
Purwokerto Lor	1213	865	2078
Sokanegara	816	473	1289
Total	3127 (60.0%)	2087 (40.1%)	5214 (100%)

Figure 4. Ovitrap Index (OI) based on location

Location	Ovitrap (+)	Number of Ovitrap	OI
Kranji	130	400	32.5
Purwokerto Lor	126	400	31.5
Sokanegara	141	400	35.3
Total	397	1200	33.1

Mosquito trap placed inside the house found more mosquitoes (60.0%) compared to mosquito trap placed outside the house (40.1%). The third village ovitrap index of 33.1% with the highest IO was found in the Sokanegara Urban Area of 35.3%.

Figure 5. Number of mosquito trapped based on type of attractant

Location	Soaking hay		Control		Total
	Number of mosquito	%	Number of mosquito	%	
Inside house	190	77.6	55	22.4	245
Outside house	133	76.9	40	23.1	173
Total	323	77.3	95	22.7	418

Figure 6. OI based on type of intervention

Location	Soaking hay			Control		
	Ovitrap (+)	Number of Ovitrap	OI	Ovitrap (+)	Number of Ovitrap	OI
Inside house	138	300	46.0%	70	300	23.3%
Outside house	128	300	42.7%	61	300	20.3%
Total	266	600	44.3%	131	600	21.8%

The number of adult mosquitoes trapped within the mosquito trap given the straw water bath attracted more (77.3%) than the number of adult mosquitoes trapped in the control mosquito trap (22.7%). The Ovitrap Index using straw water was twice as big (44.3%) than the control ovitrap index (21.8%).

### 3.3 Ovitrap effectiveness

Previously, the number of mosquitoes and ovitrap index that have been obtained is done by normality test using Saphiro Wilk method. Based on normality test results known that the data is not abnormal distribution so Kruskal Wallis test to determine whether there is influence of the use of attractiveness on the mosquito trap on ovitrap index and the number of trapped mosquitoes.

Figure 7. Association between soaking hay and OI effectiveness

Intervention	N	Mean	SD	p-value
Control	131	0.22	0.415	<0.001
Soaking hay	266	0.46	0.658	

The result of Kruskal Wallis test shows that the correlation probability value <0,001 is smaller than the significance level ( $\alpha$ ) 0.05 so it can be said that there is difference of Ovitrap

Index between treatment (hay infusion) with control (well water). This shows that the mosquito trap provided with water straw bath attractant has a higher ovitrap index compared to the mosquito trap given the well water.

Figure 8. Association between soaking hay and mosquito effectiveness

Intervention	N	Mean	SD	p-value
Control	95	0,16	0,817	<0,001
Soaking hay	323	0,54	1,641	

The result of Kruskal Wallis test shows that the correlation probability value <0,001 is smaller than the significance level ( $\alpha$ ) 0.05 so it can be said that there is a difference of the number of adult mosquitoes trapped inside the mosquito trap between the treatments (water of immersion) with the control (well water). This shows that the mosquito trap given the straw water bath attracts more mosquitoes than the mosquito trap given by the well water. The average ratio of mosquitoes in straw water compared to well water (control) was 0.38.

#### 4.0 Discussion

Banyumas has two seasons, which is 60% rain and 35% dry, and has a height of about 75 m above sea level. Temperature measurements using a thermometer show the attractiveness of the mosquito trap in the range of 24-27 0C. The temperature is still the optimal temperature for the mosquito breeding process. As proposed by Pedrosa (2010) that water temperature ranges from 25-30 0C is a potential temperature for mosquito oviposition process; similarly with water pH.

*Aedes* mosquito breeding behavior is more in the house (59.97% mosquitoes) than outdoors (40.13%). The results of this study have similarities with previous research findings that found that ovitrap installed inside the house resulted in more trapped eggs (Boewono, 1999).

This is consistent with the result of mosquito identification indicating that *Aedes aegypti* mosquito species is more dominant than *Aedes albopictus*. This condition is certainly very influential on the selection of mosquito breeding places. It is known that the type *Ae. aegypti* prefers to lay eggs in the house than *Ae. albopictus*. *Ae. albopictus* breeds in temporary containers but prefer to contain natural containers in forests, such as tree holes, leaf-axis, stone holes and coconut shells, and breed more frequently outside the home in the garden and rarely found in homes in artificial containers such as barbers and tires.

Based on the Ovitrap Index Criteria according to the Hong Kong Food and Environmental Hygiene Department (FEHD) (Sze, 2007) Ovitrap Index in Banyumas includes moderate criteria. Positive ovitrap reflects the density of adult mosquitoes that are very useful as *Aedes* spy surveillance tool and can also describe actual mosquito infestations in a region (Morato *et al*, 2005). The ovitrap index is used to find out how the region's vulnerability to dengue fever.

There is a difference between the Ovitrap Index between treatment (hay infusion) and control (well water). This shows that the mosquito trap given the water straw water attractiveness has a higher ovitrap index compared to the mosquito trap given the well water.

The results of the overall study showed that the value of OI of 44.33% hay infusion (266 positive from 600 mosquito traps) was more than that of 21.83% rainwater OI (131 of 600 positive mosquito traps). This indicates that the application of mosquito trap may affect the Aedes index (Perich, 2003; Sithiprasasna, 2003; Tarmali, 1996).

The difference of the number of adult mosquitoes trapped in the mosquito trap between the treatments (hay infusion) and the control (well water) shows that the mosquito trap given the straw water immersion athletes has a higher number of mosquitoes than the mosquito trap given by the well water.

The number of trapped Aedes mosquitoes indicates the number of eggs laid, hatching into larvae and pupae, and growing into more mature mosquitoes. This means that the gravid female mosquitoes that lay eggs in mosquito trap contain more water of soaking water than mosquito trap which contains the type of well water. In other words, the hay infusion attracts a stronger appeal than the well water

This happens because the hay infusion contains chemical compounds either in the form of gas or liquid that Aedes mosquitoes prefer. The hay infusion is known to contain ammonia and carbon dioxide. Both compounds are good attractiveness for Aedes mosquitoes. In addition to hay infusion, CO<sub>2</sub> and Ammonia are also produced from the fermentation (immersion) of organic materials such as grass, but have different quantities and qualities, giving rise to different attractions for Aedes mosquitoes. CO<sub>2</sub> and Ammonia is a compound that proves to affect the smell of Aedes mosquitoes (Thavara U, 2004). The attractiveness of mosquito traps facilitates female gravid mosquitoes to locate breeding grounds. The Aedes mosquito's odor can reach objects as far as 36 meters (Foster WA and Walker ED, 2002).

## 5.0 Conclusion and recommendation

The mosquito trap index is 21.83%, while the Ovitrap Index using the modified mosquito trap Hsu Jia Chang is 44.33%. There is a difference of modified ovitrap index with regular ovitrap index. Mosquito trap Hsu Jia Chang using hay infusion attracts more effective than well water wells. Thus, the use of mosquito trap with hay infusion can be applied as one means of controlling the Aedes sp mosquitoes in society.

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## Declaration

Authors declare that there are no known conflicts of interest associated with this publication that could have influenced its outcome.

## Authors' contribution

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