Effectiveness Of Water Filter With Circulation Method As A Control Of Larva Aedes Aegypti And Clean Water On Household Enterprises

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Abstract: ***Cartridge filter is a tool that can filter solid substances dissolved in water both organic and inorganic substances. Total Dissolved Solids (TDS) is an important indicator in water sanitation, the greater the TDS, the greater the level of pollution. Aedes aegypti mosquito is a vector of dengue disease that disturbs society, it is controlled by adult mosquito and larvae. Aedes aegypty larvae breed in bathtubs in most households. The purpose of this research was to make water filter by circulation method as a controlling tool of larval Aedes aegypti and water purifier in the bath in a household. The research used quasi-experiment, the design used pre-post test with two variable three treatment and five repetitions, the material used in this research larva Aedes aegypti and raw water and a set of the cartridge filter. The results showed a 30.4% decrease in TDS value within 30 minutes and reduced Aedes aegypti larvae to 97.2% for 45 minutes. In the Pre-post TDS test p=0,000<0,05 and Aedes aegypti Pre-post p= 0,000 <0,05 and continued with Mann-Whitney test of TDS value p = 0,001 <0,05 and Aedes aegypti p = 0.005 <0.05. Statistically, this method of circulation can decrease TDS value and able to control Aedes aegypti larva significantly. Economically this tool is still affordable by the community including production costs of Rp 2,500 to Rp 7,600 per day. This tool needs to apply the location of the source of clean water and the number of larvae free problem.***

Keywords: TDS, Aedes aegypti larva control and cartridge filter

I. INTRODUCTION

Indonesia has successfully implemented development in the health sector, but there is still a disparity between regions, especially in the control of infectious diseases and access to clean water. Dengue Hemorrhagic Fever (DHF) is an infectious disease commonly found in tropical and sub-tropical regions. Data from around the world shows Asia ranks first in the number of DHF patients each year. World Health Organization (WHO) noted Indonesia as the country with the highest dengue fever case in Southeast Asia from 1968 until 2009.

DHF is still one of the significant public health problems in Indonesia. The number of sufferers and the extent of their spreading area increases with the increasing mobility and population density. In recent years, dengue cases often appear in the transition season, especially in January at the beginning of the year. Control and prevention of dengue in the future requires close cooperation between mosquito control and Professional Organizations, communities and government agencies, to reduce vector populations and to condition citizens and visitors to take personal protective measures that minimize bites by infected mosquitoes. [1]

The dengue cases up to December 31, 2015, in Bengkulu Province reached 872 cases with 13 deaths, while in 2014 only 464 cases with 13 deaths. "The largest number of DHF cases in Bengkulu City were 355 cases in 2015 and 215 cases in 2014, following Rejang Lebong with 198 cases in 2015, while in 2014 only 77 cases". In addition to the problems of dengue, in Bengkulu also experienced clean water problems, which is often found that the quality of groundwater and river water used by the community does not meet the requirements as a healthy clean water even in some places not worth to drink. [2] Water for everyday use has a certain standard of physical, chemical and bacteriological requirements which is a unity. So if there is one parameter that does not qualify then the water is not feasible for consumption. [3]

Provision of clean water for household purposes such as drinking water, bath water, etc. must meet the requirements set by international regulations (WHO) or national regulations. In the case of clean water quality in Indonesia must meet the requirements outlined in the Regulation of the Minister of Health of the Republic of Indonesia No.32 of 2017, where every component is permitted to be in it must meet the water quality requirements according to its designation. [4]

Decent water for sanitation is increasingly scarce in urban areas. The rivers as a water source have been contaminated with various kinds of waste, ranging from disposal of organic waste, household waste and toxic waste from the industry. Groundwater is not safe to be used as drinking water because it has been contaminated by seepage from septic tanks or surface water. That is one of the reasons why clean water for household purposes is not getting attention because the community is resigned or challenging to get proper clean water.

Researchers conducted a study of Aedes aegypti larvae control technology using Catridge filter 0.3μ as Aedes aegypti larvae trap and water filter in controlling Aedes aegypti larvae and providing clean water for household purposes. This research aimed to make water filter by circulation method as a controlling tool of larva Aedes aegypti and water purifier on the bath in the household area.

II. METHOD

The type of this research was Quasi-experimental research with Pre-Pos-Test Only Control Group Design approach to see the difference of Aedes aegypty larvae and TDS value in raw water before and after treatment (15 minutes, 30 minutes, and 45 minutes). The population in this research was Aedes aegypti larva and raw water. The sample used in this research was Aedes aegypti larva and raw water. Samples were taken by grab sampling method with three treatments and five repetitions, so total samples of Aedes aegypti larvae (3 x 5 x 100 tail) were 1,500 heads and raw water (3 x 5 x 120 liter) of 1800 liters taken from drilling well Nutrition Poltekes Kemenkes Bengkulu. This research was conducted in the Workshop of Environmental Health Department of Poltekkes Kemenkes Bengkulu.

The type of data used in this research was an Aedes aegypti larva data and raw water data as primary data obtained from the results of research and secondary data from several agencies and the results of previous research. The methods of data collection in this study were by examination of dissolved solids of water samples directly with TDS meter and Aedes aegypti larvae examination by counting the number of live/dead larvae during treatment (15 minutes, 30 minutes, and 45 minutes).

III. RESULT

A. *Univariate Analysis*

Univariate analysis showed that a water pump inhaled water quality improvement and many Aedes aegypti larvae and filtered by cartridge filter, so this tool was effectively used in a household arrangement, as table 1 below.

TABLE 1. DISTRIBUTION PERCENTAGE OF TDS AFTERTREATMENT FOR 15, 30 AND 45 MINUTES

Variabel	TDS			
	Pre	Post	Decrease	%
TDS15	173,4	126,8	46,6	26,9
TDS30	163	113,4	49,6	30,4
TDS45	155,2	111,2	44,0	28,3

Table 1 showed that the TDS value of raw water sources after treatment was still below the standard. [4]

TABLE 2. DISTRIBUTION OF PERCENTAGE OF AEDES AEGYPTI LARVAE AFTER TREATMENT FOR 15, 30 AND 45 MINUTES

Variabel	Aedes aegypti			
	Pre	Post	Decrease	%
A.aegypti15	100	25,8	74,2	74,2
A.aegypti30	100	14,6	85,4	85,4
A.aegypti45	100	2,8	97,2	97,2

Table 2 showed that long-circulating filtration processes were able to control Aedes aegypti larvae up to 97.2%.

B. *Bivariate Analysis*

Bivariate analysis was used to examine the difference in the rate of TDS reduction and the number of Aedes aegypti larvae on each treatment using t-test.

C. *Test t-test*

The result of t-test with the treatment of 0.03 μm filter cartridge on the turbidity of water can be seen in table 3.

TABLE 3. THE AVERAGE DISTRIBUTION OF WATER TDS VALUE AFTER TREATMENT WITHIN 15, 30 AND 45 MINUTES

TDS	Mean	SD	95% CI	.p
Pre Test 15	173,40	0,548	43,023 – 50,177	0,000
Post Test 15	126,80	3,033		
Pre Test 30	163,00	3,162	45,615 – 53,585	0,000
Post Test 30	113,40	1,342		
Pre Test 45	155,20	7,694	35,953 – 52,047	0,000
Post Test 45	111,20	4,817		

Table 3 showed that the length of filtration time affects the water purification (p = 0,000 <0.05). The result of t-test with treatment using filter cartridge size 0.3 μ in Aedes aegypti larva control can be seen in table 4.

TABLE 4. AVERAGE DISTRIBUTION OF AEDES AEGYPTI LARVAE AFTER TREATMENT WITHIN 15, 30 AND 45 MINUTES

Aedes aegypti	Mean	SD	95% CI	.p
Pre Test 15	100,00	0,000	68,219 – 80,181	0,000
Post Test 15	25,80	4,147		
Pre Test 30	100,00	0,000	66,846 – 103,954	0,000
Post Test 30	14,60	14,943		
Pre Test 45	100,00	0,000	94,812 – 99,588	0,000
Post Test 45	2,80	1,924		

Table 4 showed that the length of filtration time affected controlling Aedes aegypti larvae (p = 0,000 <0.05)

D. Kruskal-Wallis Test Analysis

The result of Kruskal-Wallis analysis showed that there were nonhomogenous data such as TDS and Aedes aegypti decrease as follows.

TABLE 5. MEAN RANK TDS AFTER TREATMENT WITHIN 15.30 AND 45 MINUTES

TDS	Mean Rank	.p
15	13,00	0,001
30	6,20	
45	4,80	
Kontrol	18,00	

Table 5 showed a significant difference where the value of p = 0.001 <0.05, meaning that the filtration process using a 0.3µ filter cartridge was very effective at decreasing the TDS value of clean water.

TABLE 6. MEAN RANK AEDES AEGYPTI LARVAE AFTER TREATMENT WITHIN 15.30 AND 45 MINUTES

Aedes aegypti Larvae	Mean Rank	.p
15	11,770	0,001
30	8,70	
45	3,60	
Kontrol	18,00	

Table 6 showed a significant difference where the value of p = 0.001 <0.05, meaning that the filtration process using a 0.3µ filter cartridge was very useful to decrease the TDS value of clean water.

E. Test Mann - Whitney

Mann - Whitney test was performed to know the significant difference of each treatment to TDS variable and the amount of Aedes aegypti, then Mann - Whitney test, as follows.

TABLE 7. MEAN RANK TDS OF WATER AFTER TREATMENT WITHIN 15.30 AND 45 MINUTES

TDS		Mean Rank	.p
15	30	3,00	0,009
	45	3,00	0,009
	Kontrol	8,00	0,008
30	45	6,20	0,454
	Kontrol	8,00	0,000
45	Control	8,00	0,008

Table 7 showed the highest effectiveness (p = 0,000 <0.05) and the lowest (p = 0.454 <0.05) in lowering the TDS value.

TABLE 8. MEAN RANK A. AEGYPTI LARVAE AFTER TREATMENT WITHIN 15.30 AND 45 MINUTES

Aedes aegypti Larvae		Mean Rank	.p
15	30	4,3	0,209
	45	3,0	0,009
	Kontrol	8,0	0,005
30	45	3,6	0,045
	Kontrol	8,0	0,005
45	Kontrol	8,0	0,005

Table 8 showed the highest effectiveness (p = 0.005 <0.05) and the lowest (p = 0.209 <0.05) in the control of Aedes aegypti larvae.

F. Cost of Making Water Filtration Equipment and Production Cost

For the preparation of one unit of clean water filtration equipment, the materials and costs were required as in table 9; the materials could be adjusted to the location of the pump holder. Table 9 showed that for 1 unit of water filtration equipment costs Rp.663.000 (Six Hundred Sixty Three Thousand Rupiah). The amount of this fee is obtained according to the market price at the time of the research.

For the production cost of circulating water filtration into clean water by using a 100-watt electricity pump and the standard electricity tariff class R-1/900 VA-RTM (Household Capable = Non Subsidized at the cost of Rp 1.352 / Kwh) as follows:

For every time the use of water filtration (pump is turned on) for 15, 30 or 45 minutes is required cost:

1. For 15 minutes x 100 watts x 30 hr x Rp 1.352 / kwh = Rp. 76.050

2. For 30 minutes x 100 watts x 30 hr x Rp 1.352 / kwh = Rp.152.100

3. For 45 minutes x 100 watts x 30 hr x Rp 1.352 / kwh = Rp.182.520

So the production cost of water filtration was Rp. 76,050 up to Rp.182,520 per month or Rp 2,500 up to 7,600 per day.

TABLE 9. MATERIALS NEEDED FOR 1 UNIT OF CIRCULATING FILTRATION APPARATUS TO INCREASE TDS VALUE AND CONTROL AEDES AEGYPTI LARVAE

No	Item Description	Quantity	Unit	Unit Price	Total
1	Pompa Air	1	Bh	325.000	325,000
2	Pipa PVC 1"	0.5	Btg	35.000	17,500
3	Pipa PVC 3/4"	0.5	Btg	25,000	12,500
4	Pipa PVC 1/2"	1	Btg	25,000	25,000
5	Reducer PVC 3/4 " - 1/2"	1	Btg	6,000	6,000
6	Sok drat luar 1"	1	Bh	6,000	6,000
7	Sok drat luar 3/4"	4	Bh	6,000	24,000
8	Knee 1"	3	Bh	6,000	18,000
9	Knee 3/4"	1	Bh	6,000	6,000
10	Knee 1/2"	2	Bh	6,000	12,000
11	Double niple 3/4"	1	Bh	6,000	6,000
12	Stop Kran 3/4"	1	Bh	15,000	15,000
13	Sok T 3/4"	1	Bh	6,000	6,000
14	Lem PVC	2	Tb	8,000	16,000
15	Cartridge Filter 0,3 µ	1	Bh	20,000	20,000
16	Huosing Filter	1	Bh	85,000	85,000
17	Kabel	6	M	8,000	48,000
18	Stop Kontak	1	Bh	9,000	9,000
19	Steker	1	Bh	6,000	6,000
	Jumlah				**663,000**

IV. DISCUSSION

A. *The effectiveness of 0.3 µ Cartridge Filter on TDS Value Reduction*

Cartridge spun or commonly called Cartridge sediment, or PP cartridge is Cartridge filter made of spun (Polypropylene = PP) which serves to filter or filter water from the content of mud, sand, soil, colloids to produce clear water free from contamination. This cartridge can reduce the mud content in the water so that the water output becomes clear. However, the result is spun to yellow or black due to dirt that stuck in the spun. For that, it takes care to clean back the mud or soil or sand that is caught on the surface of the spun. This treatment can be done once a month or when seen has been blackened immediately cleaned again. When the spun washing can no longer be washed because it is saturated, then it is time to be replaced with a new spun. This condition usually occurs after six months or 1 year. Judging from the length of cartridge spun consists of 2 types of a size that is 10 inches long and 20 inches. Judging from its filtering ability the spun cartridge has sizes ranging from 10 µ, five µ, one µ, 0.5 µ, 0.3 µ, and 0.1 µ and should be inserted into the housing filter corresponding to the length of housing 10 inches for spun 10 inches and housing 20 inches for 20 inches spun. Cartridge with the size of this small then the mud, soil and sand, and colloid will be filtered where the size of the spun is much smaller than the size of the soil, sand, and mud.[5]

Total Dissolved Solid (TDS) is dissolved solid, either ion, compound, a colloid in water.[6] TDS is a soluble solid in a solution of either organic or inorganic substances.[7]

The working of the filter system consists of the filter housing (usually made of plastic) and filter media or filter cartridge (usually from ceramics, polypropylene, interwoven threads, spuns or granulated media). Pressurized water enters through the inlet channel and then through the cartridge filter and then out through the outlet channel. The dirt in the water gets trapped and left in the filter cartridge. The amount or amount of dirt/pollutants trapped inside the filter cartridge will depend on the size of the filter cartridge used. Filters with a size of 10 µ (0.010 mm) for example, will be able to capture pollutants of magnitude ten µ or more in diameter, whereas dirt smaller than ten µ in diameter will still permeate the filter media.

The water discharge out of the sediment filter gradually decreases, this is caused by the increasing amount of dirt/pollutants trapped inside the filter cartridge, and when the water discharge becomes so small, it means that it is time to wash or replace the filter media with the new one. [8]

The result of the analysis in Table 1 showed that the longer (time) of filtration, the lower the TDS value. The circulation method is applied than many colloids present in the water will be filtered in the cartridge filter. By the results of t-test table 3, it was known that the use of 0.3 µg filter cartridge in the dissolving process of dissolved solids was very effective p = 0,000 <0.05. The result of Kruskal-wallis test of table 5 showed that there was a significant difference between the length of treatment time in decreasing the TDS value with p = 0,001 <0,05.

The Mann-Whitenney test was an analysis to determine which component (time) was the most effective in the screening process to lower TDS. The result of Mann - Whiteney test in table 7 was known to be the highest value of p = 0,0000 <0,05 in 30 minutes in control appeal and lowest p = 0,454> 0,05 in 30 minutes from 45 treatment time.

B. The effectiveness of 0.3µ Cartridge Filter on Aedes aegypti Larva Control

Dengue Hemorrhagic Fever (DHF) caused by Aedes aegypti vector was an infectious disease that disturbs society. Various efforts hada has been done to control both adult mosquitoes and larvae. Control was done physically, chemically and biologically, in this research control was done physically to Aedes aegypti larvae with filtration using the 0,3µ result of the cartridge as table 2.

Table 2 showed that almost all (92.7%) Aedes aegypti larvae were filtered by a 0.3µ filter cartridge within 45 minutes. The t-test results in Table 4 showed that the 0.3µ cartridge filter was very effective in controlling Aedes aegypti larvae with values p = 0.000 <0,05 further to see the difference then analyzed by Kruskal-Wallis test to see the difference between component of treatment time as table 6 showed that with time range 15 to 45 minutes Aedes aegypti larvae control very successful with value p = 0,001 < 0.05, to determine which component of time was the most significant. It followed by Mann - Whitney test, the results in table 8 showed that the highest efficiency with p = 0.005 <0.05 on all treatment times compared with control and lowest with value p = 0,209> 0,05 at treatment time 15 minutes compared to 30-minute treatment. It means at this period there was no effect duration of water filtration process with the use of filter cartridges in the control of Aedes aegypti larvae in the domestic order. The first cause was the clean water from the outlet into the bathtub does not rotate (vortex) so that the larva Aedes aegypti (cocoon) is not inhaled. To produce rotating water (vortex) in the tub, the outlet end of the outlet pipe is directed against the bathtub with an angle of ± 150, so the water in the tub is always moving and the water pump will inhale all the dirt including the Aedes aegypti larvae. Both Aedes aegypti larvae have the characteristics of always moving, fast-rising surfaces to breathe and then down again to the tub and look for a quiet place so it will be difficultly inhaled by the water pump (inlet).

The world community has made many efforts in the treatment, prevention, and control of dengue fever risk factors transmitted by Aedes aegypti vectors. It has performed viral analysis of causes of DBD in the United States.[9] There is also conducted research which connects the environmental variable with the spread of Aedes aegypti vectors by utilizing satellites.[10]

An Aedes aegypti vector deployment analysis using the LISA (Local Indicator of Spatial Association) method can predict risk at an early stage at the spatio-temporal level in endemic years and can be incorporated into surveillance activities in places endemic.[11]

This research was part of the control and prevention of dengue fever which was transmitted by Aedes aegypti vector mechanically, and the result was very significant.

C. *Economic Analysis*

Table 9 showed that for the manufacture of one unit of water filtration equipment, it costed Rp.663.000 (Six Hundred Sixty Three Thousand Rupiah). As for the cost of production of water filtration in circulation into clean water by using an electric current pump of 100 watts and the standard electricity tariff class R-1/900 VA-RTM (Household Capable = Non Subsidized at the cost of Rp 1.352 / Kwh) Rp. 76,050 up to Rp.182,520 per month or Rp 2,500 up to 7,600 per day. If people use basic electricity tariff R-1/900 VA-RTTM (subsidized at the cost of Rp 586 / Kwh). So the production cost of water filtration of Rp.852 sd Rp. 2,556 per day.

The size of this cost also depended on the characteristics of the community if the habit was not efficient in terms of water and electricity use then the cost of production will also increase and vice versa.

V. CONCLUSION

TDS values decreased by 30.4% within 30 minutes after treatment using 0.3µ filter cartridge, and the results of the Kruskal-Wallis test showed significant/significant differences with p = 0.001 <0.05 before and after treatment. The number of aedes aegypti larvae that died almost entirely (97.2%) after treatment using 0.3µ filter cartridge, and the Kruskal-Wallis test showed significant/significant differences with p = 0.001 <0.05 before and after treatment. The effectiveness of the filter cartridge is 0.3µ, and the Mann-Whitney test results show a significant significant effect between the components in reducing TDS where the value of p = 0.000 <0.05, while the control of Aedes aegypti larvae also with p = 0.005 <0.05.

The results of this study can be used as recommendations to make appropriate technology that is beneficial to society. This research also can be continued by designing and adding cartridges, carbon to eliminate odors and can be added with a shower for comfort while bathing.

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