SOME FACTORS IN WATER CHEMISTRY AND PHYSICS THAT DETERMINES THE DENSITY OF DIPTERA LARVAE ON PHYTOTELMATA IN ENDEMIC AREA’S OF DENGUE HEMORRHAGIC FEVER

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ABSTRACT

As one of the breeding places, various changes in environmental factors may occur in stagnant water contained in phytotelmata, such as changes in water chemistry and physical factors that can affect the lives of insects that inhabit in that place. This study aimed to know what the factors in water chemistry are and physics that determines the density of Diptera larvae in phytotelmata in three endemic areas of Dengue Hemorrhagic Fever. The results showed that the factor of water chemistry and physics distributed to all types of phytotelmata. In phytotelmata types of taro which determines the density of larvae is the temperature, in bamboo determined by volume and pH, and in pineapple determined by Zn. However, in general, water chemistry and physical factors that determine the densities of phytotelmatas are pH with CCA score (0, 933) and temperature of the water with CCA score (0.621).

Keywords: phytotelmata, diptera, DHF.

INTRODUCTION

Phytotelmata is a natural breeding place a variety of organisms ranging from single-celled animals such as protozoa to Amphibious including aquatic insects, especially Diptera and Coleoptera, or at least occupied by one species of mosquitoes (Culicidae) (Kitching, 2000 and 2001). Phytotelmata is unique and isolated habitat, structure of metazoan communities who live in very dependent on the variations contained in phytotelmata itself, among others, capacity, age, factors abiotic / biotic (Sota *et al*., 1994; Sota and Mogi., 1996; Sota *et al*., 1997). As one of the breeding places, various changes in environmental factors may occur in stagnant water contained in phytotelmata, such as changes in water chemistry and physical factors that can affect the lives of insects that inhabit.

Some scientists have done do a research related to physical factors of water chemistry on phytotelmata, among others; Effect of volume of water and food resources from the waste leaves to the structure of insect communities in phytotelmata (Schoener, 1989; Pimm *et al*., 1991; Riece, 1994; Srivatana and Lawton, 1998); volume relationship of water and waste variability leaves against insect communities that inhabit tree holes Paradise (2004); study of some physicochemical water on the development and survival of colonization number of mosquitoes in the hole phytotelmata Delonyxregia trees in northern Nigeria Zaria (Adebot *et al*., 2008).

Phytotelmata found lives around settlements but information about the density of larvae of Diptera and relationships with the physical factors of water chemistry on phytotelmata still very limited. Indonesia as one of the endemic areas are in need of control measures against dengue disease, through plant breeding places such as phytotelmata. For the information of the results of research is needed in efforts to control insects in particular that act as vectors of diseases such as dengue. This study aims to determine the physical and chemical factors that determine water density of larvae of Diptera in phytotelmata in endemic areas of Dengue Hemorrhagic Fever.

MATERIALS AND METHODS

The study was conducted at three different locations from January to December 2012. The sampling technique to follow (Derraik, 2005) using straw. Water that has been sucked from the plant in the measuring volume, and then inserted into the bag / bottle. The samples of water that contained larvae separated from trash that carried when retrieval. Larvae were already dead were put into bottles containing 70% alcohol for later identification while surviving larvae reared to adulthood to further ensure the identification. Larvae were identified was identifying refers to the identification book (Delfinado, 1966; Pennak, 1978; Ministry of Health, Republic of Indonesia, 1989; Phua *et al*., 2008 and 2010). All larvae that have been identified calculated amount. Sampling was carried out once every two weeks. Measurement of volume and temperature of the water is done in the field, whereas the analysis of the chemical quality of water include (Calcium, Cadmium, Magnesium, Zinc, Chloride, Sodium, Sulfate), and the pH is done in the laboratory. Data were analyzed with multivariate *Canonical Correspondence Analysis* (CCA) using a computational program *Paleontological Statistics* (PAST) 2:10 version (Hammer, 2011).

RESULTS

Analysis of water chemical and physics at phytotelmata

The results of the analysis from the physics of water in phytotelmata are presented in Table-1. The highest volume of water contained in the bamboo 56 ±

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4.90 followed by the volume of water in the taro 10.34 ± 2.94 mℓ, 7.69 ± 0.76 mℓ in *pandanus* and pineapple 4.24 ± 2,30 mℓ. The highest temperatures are in taro 25.46 ±3.32°C, followed by bamboo 24.13 ± 3.05°C, in *pandanus*leaves petal 22.77 ± 0.88°C, pineapple leaves petal 18.30 ± 12.94°C. Measurement of the chemical quality of water consists of water pH and chemical elements. Phytotelmata's plant that contained pH highest in bamboo at 7.46 ± 0.78 followed by taro at 7.01 ± 0.41, *pandanus* 6.46 ± 1.05 and pineapple at 4.72 ± 3.34. Bamboo is the highest plat that containing Cadmium at 2.21 ± 0.66 mg / ℓ and the lowest is*pandanus*at 1.37 ± 0.07 mg / ℓ. Bamboo is containing highest calcium, too at 4.92 ± 1.09 mg / ℓ and the lowest is*pandanus*at 3.19 ± 0.16 in mg /ℓ. Magnesium is the highest in taro at 18.11 ± 0.33 mg / ℓ, which is the lowest is in the *pandanus* 1.36 ± 0.09 mg / ℓ. The highest sodium is in bamboo 7.57 ± 1.92 mg / ℓ and the lowest is in the pineapple 5.79 ± 0:00 mg / ℓ. Zinc is containing much in pineapple at 4.62 ± 0.001 mg / ℓ whereas the lowest in the *pandanus*2.29 ± 0.30 mg / ℓ. The highest chloride is in bamboo 7 ± 4.24 mg / ℓ and the lowest in the *pandanus*at 37.5 ± 5.27 mg / ℓ. The highest sulfate is in bamboo 23.81 ± 19.89 mg / ℓ, and the lowest in the pineapple 17.29 ± 0.001 mg / ℓ.

The density of Diptera Larvae on Phytotelmata

The highest average of larvae density is on the one of the phytotelmata's plants, *pandanus,* i.e. *Ae. albopictus* larvae at 0.60 individual/mℓ and the lowest is *Ae. aegypti* 0,03 individual/ mℓ. In taro, the most type of larvae that lives is *Ae. albopictus* 0, 56 individual/ mℓ and the lowest is *Psychoda* sp. 0, 01 individual/mℓ. In bamboo, highest number of larvae density is *Ae. albopictus* 0.363 individual / ml and the lowest are *Ae. aegypti* and *Chironomus*sp, each individual is 0.02 / mℓ. In pineapple, highest number of density larvae is *Ae .albopictus* 0.58 individual / mℓ and the lowest is *Ar. subalbatus*. 0, 03 individuals / mℓ can be seen in Table-2.

Factors determinant the water chemistry and physics larval density on phytotelmata presented in Table-3.

Seen from the types of phytotelmata, the most important things that can determine the density of Diptera larvae is larvae that inhabit in taro leaves petal with CCA score is 1, 143 (axis 1), in the other hand, if we saw from types of larvae that inhabit in phytotelmata mostly lived with *Psychoda* sp. With CCA score 0,996 (axis 1). Based on water chemical, the density of larvae is determined by water pH with CCA score 0,933 (axis 1) and if we based on water physical, the density is determined by temperature with CCA score 0, 621 (axis 1).

To find out the factor of water chemical and physical that determine the density of larvae on *phytotelmata*, have already presented in figure 1 and analyzed by using *Canonical CorespondenceAnalyisis* (*CCA*) version 2.10 (2011). It shows that the factor was distributed to *phytotelmata.* On taro, larvae that inhabit in it is *Ar. subalbatus* and *Psychoda*sp. Which have positive correlation with So4, Zn, Mg, CS, Cd, pH, So Cl, temperatureand water volume but temperature is the most determinant the density of larvae. On bamboo, larvae that inhabit in it is *Ae. albopictus* and *Ae. aegypti* and have a positive correlation with Mg, Ca, Cd, pH, So, Cl, water volume and temperature but has a negative correlation with Zn. However, water volume is the most determinant the density of larvae. On pineapple, larvae*Chironomus*sp.*, Cx. tritaeniorhynchus, Tipula* sp. have a positive correlation with Zn, So4 and temperature but has a negative correlation with Mg, Ca, Cd, pH, Cl, water volume and So and the most determinant the density of larvae is Zn.

DISCUSSIONS

The results of the analysis of the water physic, the highest volume of water found on the bamboo at 56.68 ± 4,9mg / ℓ and the lowest in pineapple at 15.87 ± 4.24 mg / ℓ. The high volume of puddles on the bamboo when compared with other types of phytotelmata can be caused due to morphological structure of bamboo stump like a tube capable of supporting and able to accommodate and maintain a pool of water more than other phytotelmata such as pandanus, taro and pineapple. Although the number of individuals in bamboo stumps is not as much as intaro plants. In taro, the leaves petal ability to hold water puddle with a large scale, too, this is because the morphology and structure of taro leaf leaves petal coincide so that they can accommodate and hold more water. In pandanus and pineapple, the average number of water volume less than the bamboo, it caused by the morphology and structure of the leaves petal leaves are small so that have limitations in accommodating the water.

If we saw from water temperature's factor, the highest is on taro which has an average at 25,46± 0,87 ^{0}C and the lowest is pineapple at 18,30 ± 12, 94 ^{0}C. It may caused by the puddles on taro leaves petal is more open and more shallow and uncover from the sun, therefore makes the water in the petals is warmer than water in bamboo's stump which have shape like a tube. Moreover, taro lives under the sun directly, not like a pineapple, although it has a leaves petal open and shallow, too, pineapple love to lives under big plant, so the petals does not exposed by the sun directly and the water on it does not warmer than taro's.

Seen from chemical's factor, the analysis' result shows that the number of degree of acidity (pH) on water from the fourth of the phytotelmata's type, the highest pH is on bamboo 7,46± 0,78 and the lowest is on pineapple at 4,72± 3, 34. It shows that the paddles on bamboo containing base or alkaline whereas the paddles on pineapple containing acid. From the result of water chemical's analysis, Chloride mostly available onphytotelmata which has 47 ± 0, 00 mg/ ℓ and the lowest is Magnesium which has 1, 36± 0,009 mg/ℓ.

Based on phytotelmatatypes, taro is the most determinant density of *Diptera* larvae with CCA score at 1,143. It may cause by chemical and physics' factor of water volume on taro more than others. Based on larvae types, *Psychoda*sp. larvae is the most determinant with CCA score at 0, 966 and already presented in (Figure-1).

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Seen from chemistry factors, pH determinant the density of larvae with CCA scores 0, 933 (Figure-1). pH's water on phytotelmata varies and is determined by the type of plant phytotelmata. From water physics factor, temperature factor determines the density of Diptera larvae is with CCA score value of 0,621. In this study, the results of temperature measurement on phytotelmata average between 18.298-26,105°C when compared with temperature range, for mosquito breeding in tree holes *Delonyxregia* in Zaria Nigeria between 21.8-28°C according to Adebote *et al.* (2008) report. The results of temperature rangesin this study is still conducive to the development of Diptera larvae in phytotelmata. Rate of growth and development of mosquito larvae can be influenced by several factors such as temperature, humidity and the amount of nutrients in the breeding places (Soegyanto, 2004). Factors affecting the breeding of organisms that occupy phytotelmata greatly influenced by the physical attributes of phytotelmata own (Adebote *et al.*, 2008).

CONCLUSIONS

From these results it can be concluded that the factor of water chemical and physics distributed to all types of phytotelmata. In phytotelmata types of taro, the density of larvae is determined by the temperature, the bamboo determined by volume and pH, the pineapple is determined by Zn. However, in general, water chemistry and physical factors that determine the densities of phytotelmatas are pH with CCA score (0,933) and temperature of the water with CCA score (0.621).

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Appendix

Table-1. The quality of water chemical and physics in Phytotelmata.

Parameter	Unit	Pandanus	Taro	Bamboo	Pineapple
Water Physical		Average ±SD	Average ±SD	Average ±SD	Average ±SD
Water Volume	mℓ	7,69±0,76	10,34 ±2,94	56,88±4,90	4,24 ±2,30
Temperature	°C	22,77±0,88	25,46±3,32	24,11±3,04	18,30±12,94
Water Chemical					
pH	unit	6,46±1,05	7,01 ± 0,41	7,46±0,78	4,72±3,34
Cadmium	mg/ℓ	1,37±0,07	1,58 ± 0,42	2,21±0,66	1,48±0,001
Calcium	mg/ℓ	3,19±0,16	4,09 ± 0,43	4,92±1,09	4,15±0,07
Magnesium	mg/ℓ	1,36±0,09	18,11± 0,33	2,25±0,15	1,93±0,001
Sodium	mg/ℓ	5,90±0,45	6,14 ± 0,25	7,57±1,92	5,79 ±0,00
Zinc	mg/ℓ	2,29±0,30	2,51 ± 0,16	2,70±0,65	4,62±0,001
Chloride	mg/ℓ	37,50±5,27	39,5 ± 2,18	57±4,42	47±0,00
Sulfate	mg/ℓ	19,30±3,02	18,55± 12,95	23,81±19,89	17,29±0,001

Table-2. The Average of larvae density (individuals/mℓ) on Phytotelmata.

Famili	**Density**(individu/mℓ)				**Total** **R**
Types	**Pandanus (n=40)**	**Taro (n=20)**	**Bamboo (n=4)**	**Pineapple (n=40)**	
I.Chironomidae					
1. *Chironomus*sp.	0,09	0,06	0,02	0,12	0,29
II. Culicidae					
2. *Ae.aegypti*	0,03	0,05	0,02	0,00	0,10
3. *Ae.albopictus*	0,60	0,56	0,36	0,58	2,11
4.*Ar.subalbatus*	0,00	0,05	0,01	0,03	0,09
5.*Cx.tritaenio*	0,13	0,18	0,04	0,20	0,56
III.Tipulidae					
6.*Tipula sp.*	0,14	0,09	0,05	0,22	0,49
IV. Psycodidae					
7.*Psycoda sp.*	0,00	0,01	0,00	0,00	0,01
Total	0,99	0,96	0,51	1,15	3,66
Total of Types	5	7	6	5	7

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Table-3. CCA score factors determinant the water chemistry and physics larval density on Phytotelmata.

		Type of PT			**Types of larvae**			**Chemistry**			**Physics**	
	axis1	**axis2**	**axis3**	**axis1**	**axis2**	**axis3**	**axis1**	**axis2**	**axis3**	**axis1**	**axis2**	**axis3**
Pandanus	-0,334	-1,049	-1,222	-	-	-	-	-	-	-	-	-
Taro	1,143	1,061	-0,407	-	-	-	-	-	-	-	-	-
Bamboo	1,077	-1,439	1,768	-	-	-	-	-	-	-	-	-
Pineapple	-1,200	0,597	0,632	-	-	-	-	-	-	-	-	-
Chi	-	-	-	-0,281	0,072	-0,087	-	-	-	-	-	-
Ae	-	-	-	0,716	-0,044	-0,181	-	-	-	-	-	-
Al	-	-	-	0,064	-0,099	0,018	-	-	-	-	-	-
Ar	-	-	-	0,452	0,614	0,148	-	-	-	-	-	-
Cu	-	-	-	-0,065	0,195	-0,040	-	-	-	-	-	-
Ti	-	-	-	-0,306	0,038	0,027	-	-	-	-	-	-
Psy	-	-	-	0,966	0,607	0,033	-	-	-	-	-	-
Zn	-	-	-	-	-	-	-0,697	0,436	0,373	-	-	-
Cl	-	-	-	-	-	-	0,222	-0,429	0,981	-	-	-
So4	-	-	-	-	-	-	0,075	0,917	0,141	-	-	-
pH	-	-	-	-	-	-	0,933	-0,438	0,103	-	-	-
Cd	-	-	-	-	-	-	0,760	-0,356	0,788	-	-	-
Ca	-	-	-	-	-	-	0,494	-0,099	0,941	-	-	-
Mg	-	-	-	-	-	-	0,370	-0,047	0,964	-	-	-
So	-	-	-	-	-	-	0,673	-0,609	0,756	-	-	-
vol	-	-	-	-	-	-	-	-	-	0,614	-0,624	0,793
Temp	-	-	-	-	-	-	-	-	-	0,621	0,295	0,703

Notes: Chi=Chironomus sp.; Ae=*Ae.aegypti*; Al=*Aedesalbopictus*; Ar= *Armigeressubalbatus*; Cx=*Culextritaeniorhychus*; Ti=*Tipula* sp.; Psy=*Psychoda* sp.; Zn=Zinc; Cl=Clorida; So4= Sulfate; Cd=Cadmium; Ca= Calcium; Mg= Magnesium; So= Sodium; Volume= water volume; PT = Phytotelmata

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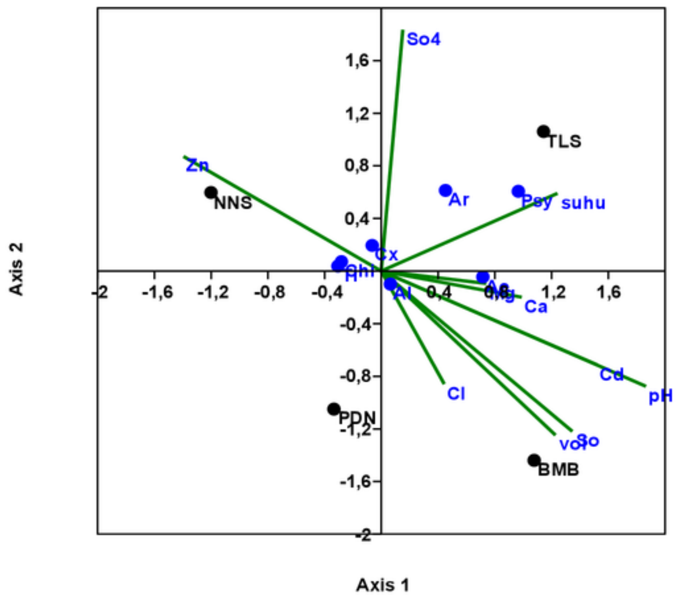

Figure-1. Factor determinant the water chemistry and physics larval density on phytotelmata PDN= Pandan; TLS= Talas; NNS= Nanas; BMB= Bambu;Ae =*Ae.aegypti*; Al= *Ae.albopictus*; Ar= *Armigeres* sp.; Ci =*Chironomus* sp.; Cx = *Culex* sp.; Ti = *Tipula* sp.; Psy = *Psychoda* sp.

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