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***Research Article***

# Nutrition Factors in Breeding Place Media and Larva Density of *Aedes Aegypti*

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## Abstract

***Background***: One of the stages of development to the growth of the *Aedes aegypti* is larvae stage. The larvae need nutrients to grow. A one of medium for breeding larvae is water in the container. Some of the important nutrients for growth are nitrate, phosphate, ammonia. This study aimed to analyze the relationship between nutrient levels in the water of the container density of *Aedes aegypti* larvae.

***Methods***: The research was observational study with a cross-sectional with 119 houses as samples. It was done in 2018-2019 in Semarang City

***Results***:Test the relationship of nutritional factors with the density of Aedes aegypti larvae using the Pearson correlation test. The average distribution of nitrate was 0.787 mg / l, phosphate was 0.186 mg / l while ammonia was 0.603 mg / l and larval density was 66 tails. The study found that there was a correlation between the levels of nitrate, phosphate, ammonia and the density of Aedes aegypti larvae (p = 0.055 r = 0.022; p = 0.001, r = 0,929; p = 0.92, r = 0.975).

***Conclusion***:The conclusions of this study were given the biggest contribution to the growth of *Aedes aegypti* larvae. A cooperative effort is needed to eliminate *Aedes aegypti* larvae.

**Keywords**: Nutrient (Nitrate, Fosfat, Ammonia), Water Breeding place, larva density *Aedes aegypti*

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## Background

Dengue Hemorrhagic Fever (DHF) is a disease caused by dengue virus transmitted through the bite of the Aedes aegypti mosquito in the tropics and subtropics.[1] Current research has found that the virus is not only transmitted through an intermediate mosquito bite, but can be transmitted transovarially on the eggs, where this will grow into an adult mosquito that has the potential as dengue vector.[2,3]

Dengue fever is still a problem in the city of Tanjungpinang where the Incident rate in 2018 was 61.14 per 100 thousand population where this figure is still higher than the national IR of 49 per 100,000 population.[4] In 2018 cases of dengue fever in Tanjungpinang increase 347 compared to 2017 with 78 cases. The highest distribution of distribution was found in the area of the Batu 10 Health Centers in, which was 115 patients and the lowest was in the Tanjung Pusat Puskesmas in 14 cases.[5]

Cases of DHF in the working area of Batu 10 Health Centers are still high and the results of larvae monitoring are far from what is required (91.7% and 85.9%). Thus the region has a risk of transmitting dengue fever[6]. Growth and proliferation of Aedes aegypti larvae are influenced by nutritional factors that exist in container water. Environmental conditions and nutrients that are important for the development and growth of Aedes aegypti larvae include pH, temperature, salinity, nitrate, phosphate, and ammonia [7-9] The growth of Aedes aegypti larvae related to the pH of water in the range between 6.0 - 7.5.8 occurs, whereas at pH ≤ 3 and ≥ 12 larvae will die. The water temperature is between 23˚C - 27˚C potential for larval development, for the salinity of potential water in the range 0 - 0.07%.[10]

Likewise with nutrients such as nitrate ranging from 0.37 to 0.47 mg / l, 11 levels of 5 mg / l, 12 0.580 mg / l, 13 5.123 mg / l, 0.897 mg / l 7 For phosphate levels around 0.049 mg / l 13 0.39 - 0.50 mg / l 7 while for ammonia levels 0.18 - 8.48 14 0.08 - 2.1 mg /l. 15 0.421 - 2.013 mg / l 16. Availability of nutrients nitrate, phosphate, and ammonia has been tested by researchers before, it was found that there was an effect on the density of Aedes aegypti larvae in various types of water breeding place media. Thus, it is necessary to conduct more in-depth studies related to nutrition in water breeding place media such as nitrate, phosphate, and ammonia with Aedes aegypti larvae density.

## Methods

This type of research is an observational study with a cross-sectional approach. The population in this study is the existing media water in containers in homes or buildings that tested positive for larvae from the results of larvae by Jumantik and 10 Health Centers in Batu officers during the study. The sampling technique uses total sampling. The number of samples measured by nitrate, phosphate, ammonia and larvae density in the air breeding media was 119 containers. Measurement of nitrate, phosphate, ammonia levels in water breeding media using a portable photometer ZE-200. Measurement of pH, temperature using a pH meter and a digital thermometer, salt levels are measured using a salinity refractometer. Calculation of larvae density of Aedes aegypti was carried out by a single larva method and then identified using a microscope to find out the species in Class II KKP entomology laboratory Tanjungpinang.

## Results

Tanjungpinang City is one of the cities in Riau Islands that has a wet tropical climate with temperatures ranging from 27.7 ° C, humidity 81.5%, and rainfall 15.72 mm with a number of rainy days 20 days per month with a medium population density level where the population is 271,645 people with a growth rate of 1.13%. The population distribution is still uneven where the most population lives in Tanjungpinang Timur District around 42.13%. Tanjungpinang has hard soil in the form of bauxite and it is difficult to absorb water. Therefore, even though the rainfall is quite high, the supply of clean water is still a problem that cannot be solved by the local government and causes residents to have a habit of storing water in drums, buckets, and others. Conceptually, Tanjungpinang is an area with an optimal climate for breeding Aedes sp. Therefore, cases of dengue fever in Tanjung Pinang occur every year. Cases of DHF still occur mainly in areas that have difficulty in getting clean water both in quality and quantity so that the average community stores water in large volume size, without a cover and is rarely drained so that the potential for Aedes aegypti larvae breeds.[10,17] Density of larvae closely related to the existence of Aedes aegypti larvae breeding grounds. Natural and artificial breeding grounds can accommodate water in small or large volumes that have the potential as a place to carry out the process of growth and development of larvae into adult mosquitoes.[8] The results of univariate analysis of nitrate, phosphate, ammonia and larvae density in 119 positive water breeding place media containing larvae obtained mean nitrate value of 0.787 with a standard deviation of 0.342; mean phosphate of 0.186 with a standard deviation of 0.103; mean ammonia 0.601 with a standard deviation of 0.334; mean larval density of 66 with a standard deviation of 34 (Table 1)

Table 1. Distribution of nitrate, phosphate, ammonia levels

| | **Mean** | **Min** | **Max** | **Median** | **SD** |
|---|---|---|---|---|---|
| **Nitrate** | 0,787 | 0,198 | 1,375 | 0,785 | 0,342 |
| **Fosfat** | 0,186 | 0,010 | 0,364 | 0,187 | 0,103 |
| **Ammonia** | 0,603 | 0,030 | 1,210 | 0,601 | 0,334 |
| **Larvae Density** | 66 | 7 | 125 | 66 | 34 |

While the results of bivariate analysis about the relationship between levels of nitrate, phosphate, ammonia and larval density in the air breeding place media obtained Pearson correlation values (r) above 0.8 and below 1.00 shows that there is a very strong relationship between phosphate, ammonia with density larvae. For the relationship of nitrate with larval density obtained a weak relationship strength where r values above 0.2 and below 0.4. For the p-value $<0.05$, the conclusion is there is a relationship between nutrients namely nitrate, phosphate and ammonia with larval density

Table.2 Results of Pearson Correlation Analysis

| **Dependent Variable** | **Independent Variable** | **r** | **P-value** | **N** |
|---|---|---|---|---|
| Density of *Aedes aegepty larvae* | Nitrate | r = 0,209 | p < 0,022 | 119 |
| | Fosfat | r = 0,929 | p < 0,001 | |
| | Ammonia | r = 0,975 | p < 0,001 | |

This study can be seen about the description of levels of nitrate, phosphate, ammonia and larval density in the medium of breeding water in line with previous studies. The mean value of nitrate levels in this study amounted to 0.787 mg / l. The results of the measurement of nitrate levels are almost the same as previous studies that the nitrate levels of 0.591 and 0.580 in the media of ovitrap water, well water 5,123 mg / l, chicken feces polluted water by 0.837 mg / l and 3.573 mg / l.[7] 0.482 mg / l , amounting to 0.22 mg / l 11 0.36 mg / l in septic tank water.[8] While in positive water larvae obtained a mean value of 0.57 mg / l.[9] in positive containers in urban areas obtained 0.42 mg / l and rural 0.22 mg / l [11] and 5.573 mg / l in soil polluted media.[16] Phosphate levels in previous studies obtained phosphate levels in detergent polluted water media were 0.39 mg / l, 0.46 mg / l, 0.50 mg / l, [7] in artificial water container media 0.33 mg / l, [9] in ovitrap media mean values of 0.43 mg / l and 0.49 mg / l, 9 mg / l, [13] in positive containers phosphate content 0.33 mg / l [11] In the Indian region on larva positive drums found phosphate levels [18].

As for the mean value of ammonia levels in this study amounted to 0.603 with a standard deviation of 0.334, where the results of the measurement of ammonia levels were the same and different from previous researchers namely in urban water containers 0.30 and rural areas 0.24.11 in larva positive containers 0,92-4,47 mg / l, [19] in soil polluted media of 2,013 mg / l.7, 0,421 mg / l and 2,013 mg / l, 16 in dug well water obtained 0.20 mg / l, in wells of 0.42116 and sewer water of 2.1 mg / l, 15 Measurements made by revelation in PDAM water 0.004 mg / l, l rainwater 0.19 mg / l, well water 74 mg / l and straw soaking water 8, 48 mg / l 14 while leachate water is 326 mg / l and water hyacinth soaking water is 35.5 mg / l done by Indira et al.[20]

The density of larvae in the medium of breeding water this study obtained a mean value of 66. The results of previous studies were obtained in the medium of positive larvae water highest 37 and lowest 3.19 The number of larvae in the study Yahya et al in 1873 well water larvae and the lowest in dirty water 11 larvae. 15 In the soil polluted water media obtained the number of larvae 50-100 larvae.

Indira et al obtained the smallest number of larvae 23 and the largest 73 larvae. While the number of larvae carried out Meanings obtained the smallest number of larvae 67 larvae and 115 larvae.21 Upik et al obtained the smallest number of larvae of 2 larvae and the highest 97 larvae.[7]

The availability of nutrients in the form of nitrate, phosphate, and ammonia is thought to have a relationship to the density of Aedes aegypti larvae, wherein the type of nutrient form is a nitrogen and phosphorus compound which is a macronutrient for most living things. The results of this study obtained nitrate levels of 1.245 with 125 larvae while at 1.235 levels obtained 97 larvae this explains the weak role of nitrate in the development and growth of larvae due to the presence of other competing organisms in container water, where nitrate in the form of nitrogen is the main nutrient needed plankton.[22] The existence of nitrogen as a chemical element that can be consumed directly by aquatic organisms. This is in line with research on nutrition using, glucose combined with nitrate can stimulate bacterial production on leaf surfaces in the laboratory as food for the Culicidae family larvae. 14 larvae while the nitrate content of 5.753 in the soil polluted water obtained the number of larvae 824.[24.25]

The period of development of the immature stage depends on the availability of variations in phosphate levels as nutrients (0.025-1.6g / larvae/day). It is known that rapid development at a high/sufficient nutritional level is 8.5 days while at a low nutritional level can reach 18.5 days.[26] The results of this study regarding phosphate levels as a nutritional factor to the growth and development of Aedes larvae have a relationship strength where the number of larvae 15 tail at a phosphate level of 0.046 is almost the same as the results of research conducted by Rizka on ovitrap water media with a phosphor content of 0.046 mg / l obtained the number of larvae of 15.13 50 obtained the number of 24 larvae in line with this study the 0.50 phosphate levels obtained 24 larvae.[7]

The number of larvae obtained 125 with ammonia levels of 0.720 mg / l shows that ammonia contributes to the growth and development of Aedes Aegypti larvae. This is due to organic matter that produces ammonia and carbon dioxide compounds that affect the olfactory nerve of Ae.aegypti.[14,16,20,27] based on research by Wenzierl et al. explained that chemical stimuli in the form of ammonia compounds became attractants to encourage female mosquitoes to lay their eggs. According to Christoper, an ammonia substance with a content of 120 mg / L has a very strong attraction for female mosquitoes to lay their eggs, while an ammonia content of more than 300 mg / L in a medium can be a mosquito repellent substance for laying eggs. The presence of ammonia in groundwater contains only a small amount of NH3 because NH3 can stick to clay grains during the infiltration of water into the soil and is difficult to escape from these clay grains.[24.28]

Ammonia level itself is an indicator of water pollution where the limit of permissible water is 0.5 mg/liter. The presence of ammonia in water breeding places can be used as an alternative in making lavitrap by making an attractive media that can be applied in the community, especially in the prevention of dengue fever. Lavitrap can be installed at potential locations for Aedes aegypti mosquitoes to oviposition.[14]

## Conclusion

Phosphate and ammonia levels make the biggest contribution to the growth of Aedes aegypti larvae. Comprehensive efforts are needed to eliminate Aedes aegypti larvae. Control of Aedes sp larvae is not only the responsibility of the health sector but all sectors. One effort to control is to implement integrated vector management, where the implementation involves all sectors ranging from central or regional policymakers, public or private agencies engaged in health and non-health as well as the active role of all levels of society.

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