Mercury Test on macroalgae from Burung and Tikus Island, Jakarta

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Abstract. Environmental pollution, caused by the introduction of hazardous substances such as heavy metals into coastal waters, affects not only the condition of the waters but also the source of food that will be contaminated by hazardous metals, one of them is mercury (Hg). Mercury is toxic metal which could cause damage to the human body in certain threshold amounts. The aim of this study was to determine the content of mercury in several species of algae from Burung and Tikus Island, Jakarta. This study was using a descriptive method. The samples were collected from Burung and Tikus Island by simple rundown sampling. Mercury level was measured by NIC3000 mercury analyzer tool. The results showed that none of the mercury levels have passed 0.5 mg/kg (the safety standart level of mercury by SNI (Indonesian National Standard)7387 in 2019) mangrove. From tikus Island had lower total mercury than the ones from Burung Island. Burung Island is located near Pari Island which is a residential area, where pollution is more likely to occur.

1. Introduction

Indonesia is an archipelagic country which has 81,000 km long coastline, where many Indonesian people lived in coastal areas as coastal communities. The presence of pollution in the coastal areas, is very dangerous, not only to habitats but also humans who always have food intake daily from the sea. Miller [1] defines pollution as adding something to the water, air and soil and foods that endanger human health, endurance human activities or other living organisms. Whereas based on the Law No.23 1997 Anonymous [2] pollution is the entry or inclusion of living things, substances, energy, and or other components into the environment by human activities that cause mal function environment.

Coastal pollution can come from domestic waste products, oil spills from ships, and tailings. The source of the contamination contains heavy metals. Soemirat in Setiawan et al. [3] was stated that the toxicity of heavy metals in organism depending on aspects such as species, how to enter the body, frequency and duration of exposure, toxicity concentration and the susceptibility of various species to be toxicants. Mercury was high toxicity that can accumulate in the aquatic environment and became the complex compounds link together with organic and an organic materials [4].

The existence of heavy metals (mercury) in seawater can be derived from the activities of humans then enter through the river, can also come from the atmosphere that falls into the sea or come from volcanic activity [5]. The pollution activity involves exposure of heavy metals, including mercury
Setiawan et al. [6]. If mercury is accumulated in a food that consumed by humans it could be harmful, since mercury compounds can be stored permanently in the body, and enzyme inhibition or cell damage could occur permanently [4]. It is also stated by Setiawan et al. [3], that the bioaccumulation of heavy metals in aquatic organisms as a result of pollution activity is an important criterion of the impacts, particularly on food-exposed humans [3], or other sources of food originating from the sea, like sea algae. Marine algae are one of the leading commodities of fisheries that have great opportunities as a new food source, considering the various types. Therefore, a study on algae exposed to heavy metals (mercury) needs to be done.

2. Methodology
This study was conducted in January 2016. This study was using the descriptive method. The samples in this study were algae that found in the waters of the Burung and Tikus Island. Sampling of algae was done by a simple rundown sampling. The stages of data collection were preparation, collecting of secondary data, implementation and sample analysis phase. Mercury sample analysis was done using NIC3000 mercury analyzer tool.

2.1. Tools and materials
The tools used in this study were mercury analyzer NIC3000, analytical scale, cup, 250 ml beaker glass, 250 and 100 ml measuring flask. Tools for sampling were snorkel, plastic, and labeling tools. The material used in making the standard curve mercury test were L-cysteine solution, concentrated HNO₃ and deionized water.

2.2. Stages of Testing
Samples were collected into a transparent plastic and stored in the freezer. The preparation of samples, the making of standard mercury curve and the mercury test were then conducted. The standard mercury curve was made before mercury testing was performed. The use of L-cysteine was to stabilize the standard Hg solution prepared.

3. Result and Discussion
Table 1 showed a list of the algae obtained in the waters of Burung and Tikus Island, there are 7 species of algae. These algae were belonged to the groups of Phaeophyta (brown algae) were containing carotene pigment, xanthofil, fucoxanthin [7], were Dictyota, Hormophysa, Padina. While other species were found to be classified as Chlorophyta (green algae) were containing a and b pigment of chlorophyll, carotene, xantofil, lutein [8], were Caulerpa and Halimeda macroloba. The latter was from Rhodophyta (red algae) group were containing phycoerythrin pigment, fucoxantin, fukosianin [7], were Galaxaura fasciculata and Hypnea.

Algae found on Burung and Tikus Island were algae that have low economic value. But it has an opportunity as a new source of food from the sea because the functional properties of Phaeophyta, Chlorophyta and Rhodophyta. Rhodophyta have the content of karegenofit and agarofit, while Phaeophyta has alginofit content and Caulerpa (Chlorophyta) may serves as food. Karegenofit, agarofit and alginofit have functional properties as thickener, gelling, emulsifiers, stabilizers, suspending, flavor softener, crystallization prevention [8], which could be used as additives to the cosmetic, pharmaceutical and food industries. Table 1 shows the total mercury content of algae:
Table 1. Result of mercury test in algae found in the Burung and Tikus Island.

| Names of Algae       | Average of Hg (μg/kg) |
|----------------------|-----------------------|
|                      | Tikus Island | Burung Island |
| Dictyota sp          | 31.3         | 40.16        |
| Hormophysa sp        | 18.83        | 46.07        |
| Padina sp            | 20.79        | 35.94        |
| Caulerpa sp          | 33.33        | 64.81        |
| Halimeda macroloba   | 6.64         | 42.2         |
| Galaxaura fasciculata| 23.98        | 64.32        |
| Hypnea sp            | 29.12        | 40.1         |

All of marine algae species was found had a total mercury of 6 to 64 μg / kg. The quantity of mercury was still below the threshold specified in SNI 7387 [9]. The maximum limit of heavy metal contamination in food for mercury at about 0.5 to 1.0 mg / kg. This proves that the algae were safe to serve as a new food source from the sea.

Based on data in table 2, the algae found on the Tikus Island were still feasible or safe for consumption and algae found on Burung islands were unfeasible or safe for consumption partially.

All of the algae were found in the site of Burung Island had high mercury content compared to algae found in the Tikus Island. Burung Island had coordinates location of S.05.86654 and E.106.60470, while Tikus Island was S.06.00389 and E.106.77889. Burung Island is closer to Pari Island (S.05.8575 and E.106.6181) (figure 1) than to Tikus Island. Pari Island is the type of island which have residential population, so domestic waste from Pari Island could spread to the Burung Island, so the accumulation of mercury total found in Burung Island was bigger than Tikus Island. Although for the both had mercury accumulation were still below the threshold of the Indonesian National Standard for the maximum limit of heavy metal (mercury 0,5 mg/kg) [9].

![Figure 1. Map of Pari Island](Source: Corvianawatie et al. [10])
Table 2. The feasibility of algae consumption.

| Names of Algae | Mean Total Hg (μg/kg) | Provisional Toreable Weekly Intake Hg (mg/kg) | Level of consumption feasibility |
|----------------|-----------------------|-----------------------------------------------|---------------------------------|
|                | In The Tikus Island   | In The Burung Island                         | In The Tikus Island             | In The Burung Island             |
| Dictyota       | 31.30                 | 40.16                                         | not feasible                   | not feasible                    |
| Hormophysa     | 18.83                 | 46.07                                         | not feasible                   | not feasible                    |
| Padina         | 20.79                 | 35.94                                         | not feasible                   | not feasible                    |
| Caulerpa       | 33.33                 | 64.81                                         | not feasible                   | not feasible                    |
| Halimeda macroloba | 6.64              | 42.20                                         | not feasible                   | not feasible                    |
| Galaxaura fasciculata | 23.98           | 64.32                                         | not feasible                   | not feasible                    |
| Hypnea         | 29.12                 | 40.10                                         | not feasible                   | not feasible                    |

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| Dictyota       | 31.30                 | 40.16                                         |
| Hormophysa     | 18.83                 | 46.07                                         |
| Padina         | 20.79                 | 35.94                                         |
| Caulerpa       | 33.33                 | 64.81                                         |
| Halimeda macroloba | 6.64          | 42.20                                         |
| Galaxaura fasciculata | 23.98     | 64.32                                         |
| Hypnea         | 29.12                 | 40.10                                         |

4. Conclusion
Based on mercury total test all, of the algae found in the Burung and Tikus Island (Dictyota, Hormophysa, Padina, Caulerpa, Halimeda macroloba, Galaxaura fasciculata and Hypnea) have been contaminated by heavy metals mercury but have not exceeded the permissible limit according to SNI (Indonesian National Standard) 7387. It is necessary to develop the study of the impact of heavy metals on other marine biota or other sources food from the sea for safety food.
5. References

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