Heavy Metal Uptake Capacity By Floating Plant Island in Sail River Pekanbaru

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Abstract. Heavy metal is one source of pollution from industrial waste. The presence of heavy metals can cause health problems and environmental problems. This research was conducted to determine the ability of floating plant islands to absorb heavy metals. This floating plant island consists of 3 different types of aquatic plants namely Hydrilla verticilata, Limnocharis flava and Echinodorus palifolius. The heavy metals measured were Pb, Cr, Cd, Zn, Cu and Fe. Measurement of heavy metals is carried out at 15 and 30 days interval. The results showed that the highest rate of absorption of heavy metals was Fe. In Hydrilla verticilata the absorption rate is 17.39 μg / g per day, Limnocharis flava is 2.22 mg / kg per day and Echinodorus palifolius is 2.63 mg / kg per day.

Keywords: Hydrilla verticilata; Limnocharis flava; Echinodorus palifolius

1. Introduction

Sail River is one of the rivers in the city of Pekanbaru. This river flows through four subdistricts in Pekanbaru, namely Lima Puluh, Sail, Tenayan Raya and Bukit Raya Districts [1]. Its location in an urban area makes the sail river polluted with various activities such as industry and discharge from various human activities. [2] stated that sail river water quality bad/low and has been polluted. The presence of pollutants, especially heavy metals in the river sail may cause a decrease in water quality and threaten the sustainability of aquatic biota.

Aquatic plants play an important role in aquatic ecosystems. In addition to providing habitat and shelter for fish and zooplankton, natural plants also inhibit the growth of phytoplankton, thereby increasing the clarity of a waters [3]. Because of the importance of the role of aquatic plants, it has been made some artificial modifications in order to improve the quality of waters, one of which is the creation of artificial floating plant islands. The use of floating plants island as an effort to improve water quality have been carried out and shows fairly good results [4,5,6].

The use of aquatic plants as a phytoremediator has been widely carried out and researched. However, the number of species tested as well as the heavy metals studied is still relatively small. Therefore, this study aims to examine the ability of floating plant islands from 3 plant species, namely Hydrilla verticilata, Limnocharis flava and Echinodorus palifolius in absorbing 6 heavy metals in the sail river, Pekanbaru City.

2. Material and Methods

This research was conducted in March 2018 - April 2018 on the Sail River, Sumber Sari Ujung Street, Pekanbaru. Analysis of heavy metal parameters in water and plants using AAS (Atomic Absorption Spectrophotometry) at the Soil Laboratory of the Faculty of Agriculture at the University of Riau.
Water and plant samples were first degraded at the Integrated Laboratory of the Faculty of Fisheries and Marine Science, University of Riau.

The tools used in this study are inner tube, rope and wood for the manufacture of floating tires, coolboxes, GPS, plastic bags, label paper, markers, stopwatches, thermometer, and stationery.

The method used in this study is an experimental method by placing water plants in a net that has been hung on a floating tire in the Sail River. *Hydrilla verticilata* will be placed at 3 different depths namely 0, 0.5 and 1 meter. The content of heavy metals in water is measured by first removing major ions such as Na\(^+\), Ca\(^{2+}\), SO\(_4\)\(^{-2}\), K\(^+\), and Mg\(^{2+}\) by adding methyl iso butyl ketone, APDC, and NaDDC to facilitate the process of adsorption of heavy metals by AAS [7]. For heavy metals in the sediment also removed the major ion and then added HF until the temperature reaches 130\(^0\)C. After cold, the sample is ready to be measured with AAS using acetylene air flame. Plant samples, first dried using an oven at 105\(^0\)C for 24 hours. Add HNO\(_3\) and HClO\(_4\), then heated and added HNO\(_3\), and ready to be measured using acetylene air.

### 3. Results and Discussion

#### 3.1. Water Quality

The quality of Sail River water shows the brightness range from 7.95 – 8.87 cm, temperature 27 – 29.5\(^0\)C, pH 7.2 – 8.5, TSS 13.5 – 15.5 mg/L, DO 5.18 – 5.9 mg/L.

#### 3.2. Absorption and Accumulation of Heavy Metals

The results of studies on three different aquatic plants indicate that there are differences in the absorption ability and accumulation of heavy metals that are different in each species. The highest metal absorption is Fe metal.

![Figure 1. Accumulation Rate of Heavy Metals in Hydrilla verticilata (µg/g/day)](image)

In the *Hydrilla* sp. Species, the most heavily absorbed heavy metals were Fe with a value of 17.39 µg/g, Pb with a value of 5.85 µg/g and Cr with a value of 3.6 µg/g (Fig. 1). The highest absorption value of heavy metals Pb and Cr was found at a depth of 1 meter.
Figure 2. Accumulation Rate of Heavy Metals in *Echinodorus* sp. & *Limnocharis* sp. (mg/kg/day)

In *Echinodorus* sp. and *Limnocharis* sp., the most heavily absorbed heavy metal is Fe with a value of 2.63 mg / kg / day and 2.22 mg / kg / day (Fig. 2). In contrast to *Hydrilla* sp., The next metal that is most absorbed is Zn with a value of 2.22 mg / kg / day on *Echinodorus* sp. and 1.47 mg / kg / day in *Limnocharis* sp.

4. DISCUSSION

The low brightness of the Sail River water is caused by the influence of the high number of dissolved particles in the area. The temperature in the Sail River is relatively normal for aquatic life. In general, Sail River conditions can be categorized as less good. Inputs of waste originating from industry and household activities causes high levels of pollution, especially heavy metals. The three plants used in this study are plants that are known to be able to live in aquatic environments that are of poor quality [8,9,10].

Some aquatic plants have special mechanisms so that they can live in areas polluted by heavy metals. Plants absorb heavy metals, but minimize the effects caused by re-forming, placing heavy metals in certain areas and even excreting. In addition there are also aquatic plants that are able to develop metabolic systems so that they can continue to function well in a polluted environment [2].

The results of the research that have been carried out show that in all three plant species, Fe is the most widely absorbed heavy metal. This is because Fe is one of the heavy metals that is essential for plants. Plants use Fe as a raw material for the formation of chlorophyll [11]. The more Fe is accumulated, the higher the formation of chlorophyll.

Unlike Fe, Pb is a non-essential heavy metal. The existence of Pb that is too high in plants will disrupt the metabolic function of plants. This is because not yet found important evidence of the presence of Pb in the metabolic process [12].

The results of the study at 3 different depths showed that the highest absorption occurred at the surface for heavy metals Pb, Cr and Fe. Whereas in other heavy metals, the highest absorption occurs on the surface. According to the results of research [13] the absorption of heavy metals will increase with increasing depth. This is because the sedimentation process that occurs in these waters. However, the results of the study [14] showed that the highest heavy metals were on the surface, then decreased in the mid-depth of the waters and re-accumulated at the bottom.

In *Echinodorous* and *Limnocharis*, Zn is one of the metals that is absorbed quite high. This is because just like Fe, Zn is also one of the essential metals needed in plant metabolism. Zn is used by plants in the formation of various types of enzymes such as dehydrogenase, aldolase, isomerase, transphosohorylase and RNA and DNA polymerase [11].
Absorption of heavy metals in 3 different organs shows that the root is the organ with the highest absorption rate of heavy metals. This happens because the root is the main absorption organ in aquatic plants. The results of this study are different from [15] who found that the leaves found the largest heavy metals. [16] states that this difference he caused by differences in species and environmental factors affect the accumulation and distribution of heavy metals in aquatic plants.

5. CONCLUSION

Based on the results of the study, it can be concluded that: (1) the aquatic plants, *Hydrilla verticilata*, *Limnocha ris flava* and *Echinodorus palifolius* have different abilities in absorbing heavy metals; and (2) aquatic plants, *Hydrilla verticilata*, *Limnocha ris flava* and *Echinodorus palifolius* absorb higher essential heavy metals than non-essential heavy metals. (3) In *Limnocha ris flava* and *Echinodorus palifolius*, the organ with the highest absorption of heavy metals is the root.

6. REFERENCES

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