



The Content Of Lead (Pb) Heavy Metal In Mangrove (*Rhizophora Mucronata*) at Mlaten Village, Indonesia

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Abstract : In this study, heavy metal content (Pb) in *Rhizophora mucronata* mangrove that grows in Mlaten Village is analyzed with the average Pb content on the water in three research stations. The accumulation of heavy metal content in roots is higher than in stems and leaves. There are three types of measurements assessed in this study such as Bioconcentration Factor value (BCF; the ratio of heavy metal concentrations in roots or leaves with sediment), Translocation Factor (TF; the ratio of heavy metal concentration in leaves and roots) and Phytoremediation (FTD). The BCF value in station 1 has an average value of 0.63 while in station 2 is 0.78 and in station 3 is 0.68. The TF average value in station 1 is 0.20 and in station 2 is 0.17 while in station 3 is 0.13. Whereas, the FTD value in station 1 has an average value of 0.43 and station 2 shows an average value of 0.61 while in station 3 is 0.55.

Keywords: heavy metal content, mangrove, phytoremediation, bioconcentration factor, translocation factor.

Introduction

One of the coastal areas in Indonesia which are the Mangrove Area of Mlaten Village, Nguling District, Pasuruan Regency, Indonesia is one area that is close to the community center for fishing, fish auction, and boat harbor. Pasuruan has a total area of 147,401,50 hectares and is divided into three parts: mountainous and hilly area, lowland area (fertile area) and coastal area. The coastal area in Pasuruan is ranging from Nguling District to Lekok, Kraton, and Bangil Districts. The second area is the second largest area in Pasuruan. The agricultural area in Pasuruan is \pm 159 Ha, so it can be called that the agricultural sector is the contributor of the water waste.

In the coastal area, fishing activity is one of the pollutants in the sea. The motor boats used to catch fish are amounting to 63 pieces. There are many activities that bring some effects on the surrounding environment. It has been shown in the previous research that in the mangrove area of Nguling District the dissolved heavy metal (Pb) contained in the water is already passed the seawater standard quality. Based on preliminary research data, the average value of the Pb heavy metal content is 0.142 ppm, while based on the Decree of the Ministry of Environment No. 51 of 2004 regarding seawater standard quality, the limit for Pb in seawater is as much as 0.008 ppm. From the data above, we can conclude that the content of Pb in that region is quite high, so it is necessary to do such research to analyze the content of Pb that is contained in the roots and leaves of mangrove in Mangrove Area at Mlaten Village.

Research Methodology

Research Location and Period

Preliminary research was carried out in the Mangrove Area at Mlaten Village. After that, a water and mangrove sampling was conducted and then it was brought to be analyzed in the Laboratory of Environmental Chemistry of the Faculty of Mathematics and Natural Sciences, Universitas Brawijaya, Indonesia, while the sediment samples were analyzed in the Laboratory of Soil Chemistry of the Faculty of Agriculture, Universitas Brawijaya. Next, the mangrove plant samples were analyzed in the Laboratory of Physiology, Tissue Culture, and Microtechnique, Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Brawijaya and in the Central Laboratory of Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang, Indonesia. The research implementation and preparation took time for about four months (April - July 2016)

Research Method

This research was a descriptive research which was intended to create a systematic, factual and accurate information about the facts, the characteristics and the relationship between the phenomena studied¹. Data were collected through observation, water quality direct measurement, water sampling, sediment and mangrove vegetation sampling which consisted of mangrove roots, stems, leaves and *Rhizophora mucronata* fruits.

The first phase of the research was conducting a water sampling, sediments sampling, and mangroves sampling. Then, the samples were analyzed by using AAS method in the Laboratory of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Brawijaya, to determine the content of heavy metals (Lead / Pb) while the sediment samples were analyzed in the Laboratory of Soil Chemistry, Faculty of Agriculture, Universitas Brawijaya, to determine the soil texture and pH.

Data Analysis

The measurement which was used to determine the ratio between metal concentration in the roots/leaves with the metal concentration in the sediments was the Bio-Concentration Factor (BCF). BCF on the leaves and roots were calculated to determine the amount of metal concentration in the leaves and roots that come from the environment. The comparison between metal concentrations in leaves and roots has been known as the Translocation Factors (TF). TF value was calculated to determine the metal accumulation transfer from roots to sprouts².

Results and Discussion

The water quality research results indicated the temperature in station 1 is 33,1°C, station 2 is 33,4°C while in station 3 is 32,5°C. The water salinity in station 1 and station 2 is 24ppt, while in station 3 is 22ppt. The water pH in station 1 is 6,95 while in station 2 is 7,41 and in station 3 is 7,26. The DO in station 1 and station 2 is as much as 1,8 mg/l and in station 3 is as much as 2 mg/l. Generally, the water quality parameter such as temperature, DO, salinity, and pH is quite normal and qualified to support the aquatic organisms' life.

Table 1. Results of Water Quality Analysis

No	Parameter	Unit	Station		
			1	2	3
1	Temperature	°C	33.1	33.4	32.5
2	DO	mg/l	1.8	1.8	2,1
3	Ph	-	6.95	7.41	7.26
4	SAlinity	Ppt	24	24	21

As shown in the percentage of the sediment texture analysis, station 1 has 6% clay textured soil, 19% dust and 75% sand, and station 2 has 7% clay textured soil, 27% dust, and 66% sand, while station 3 has 8% clay textured soil, 76% dust, and 16% sand. The results of soil texture measurements in Mlaten Mangrove Area

show that the soil texture in station 1 which is close to the community center and station 2 which is close to fishing area is a sandy loam textured.

Meanwhile, station 3 which is close to a former pond area has a dusty loam textured soil. The soil texture in station 3 is different with station 1 and station 2. It probably due to the influence of ocean's wave that brought sand particles into the mangrove areas and also might be due to the influence of the input and different tidal water that goes into each station.

Table 2. Soil Texture

No	Code	% Sand	% Dust	% Clay	Texture Category
1	Station 1	75	19	6	Sandy Loam
2	Station 2	66	27	7	Sandy Loam
3	Station 3	16	76	8	Dusty Loam

Sediment quality data acquisition for soil pH observations was made on 3 stations in Mlaten Mangrove Area, Pasuruan. The results of the laboratory analysis of soil pH observations can be seen in Table 3.

Table 3. The Results Of Soil Ph Measurements in Mlaten Mangrove Area

Station	Mlaten	
	pH(H ₂ O)	pH (KCl 1N)
1	7.9	7.4
2	7.9	7.0
3	7.5	7.0
Average	7.8	7.1

The acidity level (pH) of the soil was measured by using the extracts of H₂O and KCl 1N. Generally, the results of the analysis at both sites are not so different. The average results of soil pH measurement in Mlaten Mangrove Area by using H₂O and KCl extracts are 7.8 and 7.1.

The Content of Lead (Pb) on Multiple *Rhizophora mucronata* Tissues

Lead (Pb) content measurement was performed on 3 observation stations with roots, stems, leaves and *Rhizophora mucronata* fruits sampling. The results of the laboratory analysis measurement at each station can be seen in Table 4.

Table 4. The Average Lead (Pb) Content on *Rhizophora mucronata* Tissues which Grows in Contaminated Water and Relatively Free-pollutant Water

No	Tissue Sample	Pb Content (ppm)		
		Station 1	Station 2	Station 3
1	Roots	2.24	3.95	2.11
2	Stems	0.21	0.27	0.17
3	Leaves	0.45	0.62	0.28
4	Seed	0.34	0.43	0.27

The average Lead (Pb) content contained in the water at station 1 is 0.124 ppm, at station 2 is 0.113 ppm, while at station 3 is 0.142 ppm. Furthermore, the average Pb content in the sediment at station 1 is as much as 3.54 ppm and station 2 is 4.50 ppm, while at station 3 is 3.10 ppm. The content of Pb heavy metal in the water has exceeded the limit that is allowed by the Decree of the State Ministry of Environment No. 51 of 2004 as much as 0.008 mg/l, while the sediment was still below the minimum value that is set by NOAA in the amount <30.240 ppm.

The Lead (Pb) content in the roots of *Rhizophora mucronata* at station 1 has an average value of 2.24 ppm and in station 2 has an average value of 3.95 ppm, while in station 3 has an average value of 2.11 ppm. Pb content in the leaves of *Rhizophora mucronata* at station 1 has an average value of 0,45 ppm, while in station 2 is 0,62 ppm, and in station 3 is 0.28 ppm. The average Pb content in the stems of *Rhizophora mucronata* at station 1 is 0.21 ppm, whereas in station 2 is 0.27 ppm, and in station 3 is 0.17 ppm. While the seeds of *Rhizophora mucronata* at Station 1 has the average value of Pb for as much as 0.34 ppm, and the value in station 2 for about 0.43 ppm, while the value in station 3 for as much as 0.27 ppm.

Bioconcentration Factor (BCF) and Translocation Factor (TF)

Based on the data from the Lead (Pb) concentration measurement in sediment, roots, and leaves, the value of Bioconcentration Factor (BCF) and Translocation Factor (TF) can be calculated. BCF and TF value can be used to determine the value of *Rhizophora mucronata* phyto remediation (FTD) so that it can be used as the basis of a plant to be a water phyto remediation. BCF and TF value of *Rhizophora mucronata* in each station can be seen in Table 5.

Table 5. Bioconcentration Factor (BCF), Translocation Factor (TF) and Phyto remediation (FTD) at each observation station

No.	Parameter	Station 1	Station 2	Station 3
1	BCF	0.63	0.78	0.68
2	TF	0.20	0.17	0.13
3	FTD	0.43	0.61	0.55

Table 5 shows the value of BCF, TF, and FTD. BCF value at station 1 has an average value of 0.63, and in station 2 has an average value of 0.78 while in station 3 have an average value of 0.68. TF value at station 1 has an average value of 0.20 whereas in station 2 has an average value of 0.17, and in station 3 has an average value of 0.13. FTD at station 1 shows an average value of 0.43 while in station 2 shows an average value of 0.61, and in station 3 shows an average value of 0.55.

In conclusion, the mangrove species of *Rhizophora mucronata* living in the three stations proves to be useful as the fitoremediator for the Pb-contaminated environment.

References

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