THE SURVIVAL ABILITY OF *NAJASINDICA* AGAINST THE HEAVY METAL OF LEAD (PB)

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Abstract. Water contaminationdue to the heavy metal is more widespread today. A water that has been contaminated by compounds/ions of Pbexceedingproper concentration can cause death to aquatic biota. The development of effective and efficient alternative to rehabilitate the case of heavy metal contaminant to be safe for aquatic biota is so needed. The success of aquatic plant as an agent for remediation of polluted waters has been widely demonstrated. *Najas indica* is a group of submerged aquatic plant that has been known to have the ability to remediate heavy metals.The aims of this research examines the relationship of concentration of lead (Pb) against survival ability of *Najas indica* and the effect of concentration of lead (Pb) on water pH changes and its effect on survival ability of *Najas indica*. This research was conducted at the Integrated Research Laboratory of postgraduate, Sriwijaya University. This research used a completely randomized design with three replications.Experimental treatment consisted of: various concentrations i.e. A0 = Without treatment, A1 = concentration of 5 mg/L, A2 = concentration of 10 mg/L and A3 = 15 mg/L. Analysis of Pb content in plants and in the water was measured on the 5th, 10th, 15th and 20th daywith AAS analysis method performed at a research laboratory in the Department of Chemistry, Faculty of Mathematics and Natural Science, Sriwijaya University. The obtained results from laboratory analysis was processed in Variant Analysis (ANOVA), if there was any significant effect, it would be continued by Duncan's New Multiple Range Test (DNMRT) at 5% level by using statistical software 8.0 and Survival Analysis using SPSS 16.0 software. Concentration of lead (Pb) has effect on survival ability of*Najas indica*.The concentration of lead (Pb) has effect on survival ability of*Najas indica*. Survival ability of *Najas indica* with a concentration of 5 mg/L decreased to 20% until the 20th day while at a concentration of 10 mg/L and 15 mg/Ldecreased to 35% on the 15th day.Concentration of lead (Pb) resulted in water pH changes to be acidic so that survivalability of*Najas indica* decreased. Survival ability of *Najas indica*at water pH ranging of 3,00 - 5,00 and 5,01 - 7,01 more decreased when compared to the water pH ranging of 7,02 - 9,02.*Najas indica* has the potential in the process of remediation of lead.

Keyword: Survival ability, *Najas indica*, heavy metal of lead (Pb)

I. INTRODUCTION

A byproduct of the production processes and human activities that are disposed into waters has more increased so the water gets more polluted. One ofthe pollutants is heavy metal of Pb (Lead) [9].Contamination of lead (Pb), which entered into aquatic ecosystems beyond the quality standard can cause to the death of aquatic biota, if it is used to irrigate the plants it will be absorbed into the plant tissue, then it will enter through the food chain cycle and it will be accumulated in body tissue[1] .

Plants have the ability to absorb and accumulate contaminants. The ability of each plant to adapt to different causing their level of sensitivity, which are very sensitive, sensitive and less sensitive[4]. Najas indica is submerged plantthat lives in freshwater, salty or sea water.Reference [8] show *Najas indica* can absorb wastewater containing Cu, Pb, Cd and Ni..

Water plants that are contaminatedwith heavy metals can undergo changes at the cellular level, inhibition of photosynthesis, respiration capabilities change, and inhibition of growth[13]. Every metallic element has a different response to the treatment of pH[5]. Reference [11] reported that the leaves of *Najas indica* plant exposed to Pb undergo chlorosis and fragmentation. Results of a preliminary study conducted by researchers in 2014 showed *Najasindica* able to live in acidic water condition. pH value is influenced by several factors including biological activity such as photosynthesis, respiration of organisms, temperature and the presence of ions in the water. Survival ability of*Najas indica*in remediating lead (Pb) in various concentrations are influenced by contact time.

Najas indica is a group of submerged aquatic plant that has been known to have the ability to remediate heavy metals, but not much is knownthe information about the survival ability of Najas indica from stress of heavy metal of lead (Pb). Therefore, it is necessary to study how the relationship between the concentration of lead (Pb) to survival ability of

Najas indica and the influence of lead (Pb) concentration to water pH changes and its effects on survival ability of *Najas indica.*

II METHODOLOGY

2.1 Time and Place

This study was performed in December 2014 until April 2015 at the Integrated Research Laboratory of Postgraduate, Sriwijaya University. Analysis of heavy metal Pb on *Najas indica* was performed at a research laboratory in the Department of Chemistry, Faculty of Mathematics and Natural Science, Sriwijaya University, Indralaya.

2.2. Tools and materials

The materials used in this study arestock standard solution of Pb $(NO_3)_2$ 1000 ppm, *Najas indica*, distilled water, PAM water, concentrated HNO_3 65%.
The tools used in this study are DO meter, pH meter, plastic container as a media treatment, pH meter, AAS Shimatsu AA 7000, analytical balance, erlenmeyer, filter paper Whattman, pipette, pipette volumetric, hot plate, mortar, rod stirrer, funnel glass, flask, measuring cups, oven, a set of tools vacuum filtered, sample bottles.

2.3. Procedure

2.3.1. Survey *Najas indica*.

In this study conducted a survey on the existence of *Najas indica*. Furthermore, conducted the analysis of the content of lead (Pb) in *Najasindica* and content of Pb dissolved in water. Conducted measurements on Environmental factors such as DO, water pH, temperature, TDS and conductivity. Furthermore*Najas indica*was tested on a laboratory scale.

2.3.2. Phytoremediation on a laboratory scale test

Phytoremediation test on a laboratory scale used a completely randomized design (CRD) with experimental treatments such as concentration variations with 3 repetitions.

Concentration variations with 3 level are,

B1 = Control (without treatment)

B2 = concentration of 5 mg/L.

B3 = concentration of 10 mg/L.

B4 = concentration of 15 mg/L.

2.3.3. Plant Selection

Plants are selected having uniformity of conditions, namely: coming from the same place to grow, with a 10 cm length criteria plant up to 15 cm, fresh green plant leaves.

2.3.4. Preparation of PhytoremediationMedia

Phytoremediation Media used in the form of plastic container. Then *Najas indica* Samplewas washedwith clean water to remove dirt and then acclimatized for five days.

2.3.5. Treatment of Phytoremediation

After acclimatized for five days, treatment with *Najas indica* each with a wet weight of 300 grams was put in a plastic container with a diameter of 90 cm with a height of 30 cm which already contains lead of 5 mg/L , 10 mg/L and 15 mg/L into 20 L of PAM water. The solution of lead obtained from stock standard solution of Pb $(NO_3)_2$ 1000 ppm. The number of plastic containers for phytoremediation is 24 pieces. Phytoremediation done was phytoremediation static (water made phytoremediation at quiet and not move) for 20 days with observations on the 5^{th}, 10^{th}, 15^{th} and 20^{th} day.

2.3.6. Analysis Procedure of Heavy Metal Content in Plants (*Najas indica*)

Analysis procedure of Pb heavy metal content used SNI reference 06-6992.3-2004

2.3.7. Analysis Procedure of Heavy Metal Content of Pb dissolved in water

Analysis procedures of Pb heavy metal in water used SNI 6989.8.2009 reference.

2.4. Variable of Observations

Measurement of Pb metal content in *Najas indica*, measurement of Pb dissolved content in the media as well as water pH changes were conducted on the 0, 5^{th}, 10^{th}, 15^{th}, 20^{th} day.

2.5.Data analysis

2.5.1. Variant analysis

Data of Pb content in *Najas indica*, and data content of Pb in water after the treatment then it was processed in Variant Analysis, if there was any significant effect, it would be continued by Duncan's New Multiple Range Test (DNMRT) at 5% level by using statistical software 8.0.

2.5.2. Survival analysis

Analysis of survival or survival data analysis is a method of dealing with time, starting from the initial observation until the occurrence of a specified event [3]. To interpret the survival characteristic, data required in this study are:

- Dependent variable was mortality data from plants with units of days.
- Independent variable used was factors suspected to affect the survival of plants include: concentration, content of Pb in *Najas indica* before and after treatment and water pH change data was entered in tabular form in SPSS 16.0 software.

III. DISCUSSION

3.1 Relations of concentration of lead (Pb) against survival ability of *Najas indica*

In this study the content of lead in the water is measured to ensure that lead has been made remediation by Najas indica. Variance Analysis Results showedthe concentration has significantly effect on Pb content in the water on the 5^{th}, 10^{th}, 15^{th} 20^{th} day.

Concentration has significantly effect oncontent of residual Pbin the water on the 5th, 10 th, 15 th 20 th day. The results of a further Duncan test are shown in Table 1.

Table 1
Comparison of *Najas indica* ability to remediate lead (Pb).

Plant	Concentration (mg/ Ll)	Pb content in water(mg/kg) on day			
		5th	10 th	15 th	20 th
Najas indica	0	0,00 a	0,00 a	0,00 a	0,00
	5	1,82 b	0,63 a	0,95 b	1,40
	10	4,96 c	3,66 b	1,87 c	2,56
	15	9,46 d	5,94 c	3,14 d	5,71

Description: Numeral followed by different letter in the same column show the significant difference (significant different) on a further test of DNMRT (Duncan New Multiple Range Test) α level of 5%. Numeral not followed by the letter show no significantly effect on α level of 5%.

Table 1 shows *Najas indica* at a concentration of 5 mg/L, 10 mg/L and 15 mg/L on the 5th day were significantly different when compared with controls (0 mg/L). *NajasIndica* treatment at 5 mg/Lhas no significantly effect, while at a concentration of 10 mg/L and 15 mg/L on the 10th day when compared to controls (0 mg/L). *Najas Indica* treatment at 5 mg/L, 10 mg/L and 15 mg/L were significantly different when compared with control (0 mg/L) on the 15thday. While on the 20thday there is no interaction.

In this research, survival analysis that supports research was done. In this research the meaning of survival in that sense is how a systemin *Najas indica* body can carry out function properly in the face of stress (stress) on various concentrations of Pb heavy metal. In this research, survival analysis conducted on the relationship of concentration of lead (Pb) on the ability of *Najas indica* to remediate lead (Pb) is displayed in Figure 1.

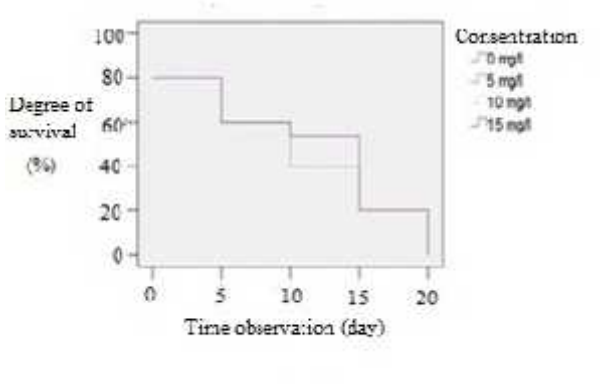

Figure 1 Survival Analysis of Concentration RelationshipAgainst the abilityof *Najas indica* In remediating Lead (Pb).

Figure 1 shows the survival ability of *Najas indica* at a concentration of 15 mg/L decreased to 60% on the 5thday, then decreased by 5% to 55%, on the 15th day decreased to 20% (a decrease of 35%) and the survival ability will be to 0% on20th day. The ability of plant to localize heavy metal depictsthat plant has tolerance and detoxification. Tolerance and detoxification capabilities possessed by *Najas indica*are done by accumulating most of the heavy metal in the vacuole in a cell structure. Vacuole is a safe place to accumulate metal due to the vacuole is an area far from the metabolic processes of the toxicity of heavy metal[6].

3.2 The effect of lead (Pb) concentration against water pH changes and its effects on survival ability of *Najas indica*.
In this research parameter measured during the observation is water pH. One of the factors that influence the absorption of heavy metal is pH of water. pH is an important factor that determines the metal transformation. pH value of water can affect the accumulation of heavy metal in water and aquatic organism, because the lower the pH of water, the heavy metals more soluble in water (ionic form) so that more easily enter into aquatic organism. The increase in pH will decrease the solubility of metal inwater, because it will change metalfrom carbonate form to hydroxy form forming a bond with particle in water bodies[2]. Changes in pH of water is shown in Table 2.

Table. 2
The average of water pH

Plant	Concentration (mg/l)	Time Observations (on day)				
		0	5th	10 th	15 th	20 th
Najas indica	0	7,82	6,10	6,51	6,13	6,09
	5	7,82	3,70	4,66	3,70	3,71
	10	7,82	3,39	3,65	3,64	5,02
	15	7,82	3,38	3,54	3,50	3,46

Table 2 shows on*Najas indica*, in the treatment of 5 mg/L, 10 mg/L and 15 mg/L change of pH of water is fluctuating. Where at 5 mg/L on the 5th day pH of water is to 3,70 and increased slightly to 4,66 on the 10thday and back down on the the 15th day and the 20th day. While at 10 mg/L, pH of water is respectively 3,39, 3,65 and 3,64 onthe 5th, the 10th, and the 15th day, on the 20th day pH of water increased to 5,02. Although in general the change in pH of water is fluctuating but still within the range of acidic pH. The absorption of heavy metal in plant is influenced by many factors such as the characteristics of physic, chemistry, and growth media used. These factors include pH, ion exchange capacity, base saturation, cation exchange, and others.

The pH value of water is very important to be known because to determine whether nutrient ions are absorbed easily or no and also indicate the existence of elements that are toxic to organism [7]. Survival Analysis Results of

relationshipof water pH against *Najas indica* ability is shown in Figure 2.

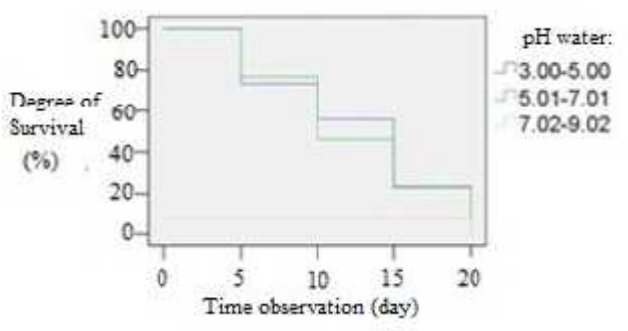

Figure 2. Survival Analysis of Relationship of water pH against *Najas indica* ability in absorbing heavy metal of lead (Pb).

Water pH affects the ability of *Najas indica*to absorb heavy metal of lead (Pb). Figure 2 shows the survival ability of *Najas indica*at water pH ranging of 3,00– 5,00 has decreased to 75% on the 5th day, and then decreased to 58% onthe 10th day, and decreasedon the 15th day to 20%, and the survival ability to 0% on the 20th day. The survival ability at water pH ranging of 5,01 - 7,01 has decreased to 78% on the 5th day, then decreased to 50% the 10th day, the 15th day decreased to 20% and the survival ability will be 0% on the 20th day. The survival rate at water pH ranging of 7,02 - 9,02 in the amount of 10% is still stable up to the 20th day. the decrease in water pH drastically can increase the solubility of metal[7]. Reference [12]that biosorptionis affected by the type of plant species (genus/species) used, the form of processes such as: temperature, pH, biomass concentration, and concentration of heavy metal. In this research can also be shown that the duration of stay is one of the factors that influence of metal absorption.Reference [10] showthat external factor which so influenced of the metal absorption by plants is climate, fertility, plant health, and duration of treatment.

IV. CONCLUSION

From the research that has been done can be conclude as follows:

1. The concentration of lead (Pb) has effect on survival ability of*Najas indica*. The survival ability of*Najas indica* with concentrations of 5 mg/Ldecreased to 20% until the 20th day while at concentration of 10 mg/L and 15mg/Ldecreasedonthe 20th day by 35%.

2. The concentration of lead (Pb) resulted in water pH changes to be acidic so that the survival ability of *Najas indica* decreased. the survival ability of *Najas indica*at water pH ranging of 3,00 – 5,00 and 5,01 – 7,01 decreased when compared to the water pH ranging 7,02 – 9,02.

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