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ACCUMULATION OF HEAVY METALS WITHIN HARD CORAL *Porites lutea* IN SPERMONDE ARCHIPELAGO, SOUTH SULAWESI

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ABSTRACT

Hard coral *Porites lutea* is an animal that lives on the ocean floor. This species may live for years and accumulate heavy metals from its surrounding environments. The aims of this study was to know accumulation of heavy metals (Pb, Cd, and Cu) pollution by *Porites lutea* at different islands in Spermonde Archipelago waters. This study used field surveys around Laelae, Bonebatang and Badi Islands of South Sulawesi. Field parameters measured were oceanographic parameters, metals in water and sediment. Hard coral was extracted using nitric acid, then measured its heavy metal levels using Atomic Absorption Spectrophotometer. Several field parameters such as temperature, salinity, turbidity, pH and dissolved oxygen indicated no differences at each location, whereas the difference was observed in the values of Total Suspended Solid and dissolved oxygen. The results showed the accumulation of heavy metals in the skeleton of *Porites lutea* was Pb>Cu>Cd and Laelae>Bonebatang>Badi Island.

Keywords: accumulation, heavy metals, pollution, skeleton *Porites lutea*

INTRODUCTION

Development of both residential and industrial activities in coastal areas has increased along with the population growth. These activities produce byproducts such as solid and liquid waste that will pollute the marine environment. The composition of this waste consists of organic and inorganic materials (heavy metals). Industrial activities are done by humans are source of metal pollution. Heavy metals are common marine pollutants that emanate from such sources as industrial and sewage treatment discharges and antifouling paints (Mitchelmore *et al*. 2003). These industrial wastes containing heavy metals such as mercury (Hg), cadmium (Cd), lead (Pb), copper (Cu), and zinc (Zn). These elements have strong toxicity (high toxicity), so that reduce the quality of water and to poison the organisms that live in it.

Some organisms that live in the sea have the ability to accumulate heavy metals in their bodies. Some plant species such as seaweed, seagrass and animal species such as shellfish are able to accumulate heavy metals. Sponge is one type of coral that capable to accumulate heavy metals. Van Hansen *et al*. (2000) reported that the marine sponge *Halichondria panicea* cosmopolitan species capable of accumulating metals Cu, Zn and Cd. The same thing was reported by Cebrian *et al*. (2003) who observed the sponge *Crambe crambe* accumulate copper, tin and vanadium in bulk. The increase in the heavy metals in coral skeleton may reflect the environmental factors besides the anthropogenic impacts (Esslemont *et al*. 2000). There is a rapid increase of threats to corals owing to the increase of coastal activities along the coastline expansion, damage by maritime activities, inorganic and organic pollution, oil pollution, shipping processes, tourism and lack of public awareness (Dar and Abdel-Wahab 2005; Madkour and Dar 2007).

However, studies conducted in Spermonde showed that the sediment and sea waters near the mainland have experienced contamination (Mallongi, 2014; Werorilangi *et al*., 2016). While, there is no study about monitoring of heavy metals using hard coral *Porites lutea* in Spermonde Archipelago waters. In addition, contribution of the mainland to accumulation of heavy metal may different from the Makassar due to differences in magnitude length.

The aim of this study was to monitor heavy metals contamination using hard coral *Porites lutea* accumulation in different oceanographic conditions. We tested the hypothesis that accumulation level of heavy metals Pb, Cd and Cu in *Porites lutea* would be greater on island closer to the mainland.

MATERIALS AND METHODS

Study Sites and Sampling

Spermonde Archipelago is located in the west of South Sulawesi. Samples of hard coral *Porites lutea* were collected from three different localities representing different distances from the mainland (Laelae Island, 0.68 mile from mainland; Bonebatang Island 8.16 mile and Badi Island 11.4 mile (Figure 1). Preparation of hard coral *Porites lutea samples* was conducted in the Laboratory of Chemical Oceanography, Faculty of Marine Science and Fisheries, Hasanuddin University. Levels of heavy metals measurements performed in the Laboratory of Environmental Health Makassar.

The research was conducted with explorative method designed to describe the accumulation of heavy metals from waters by hard coral *Porites lutea*

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Figure. 1 . Site location

(levels of heavy metals Pb, Cd,and Cu). All glassware and sampling bottles and bags were then soaked in 1M nitric acid for 24 hours. Before being used, all the glassware, sampling bags and bottles were washed with deionised water and dried.

Collection of hard coral colonies from various study sites in order to quantify the degree of pollution in the field. Small coral colonies were collected from the reef flats of Laelae, Bonebatang and Badi Islands from three different sites as specified in Figure 1, using a hammer and a chisel. Thecoral colonies were placed into plastic bags and transported to the laboratory, Sampling was done three times on each reef field parameters measured during sampling trip were temperature, flow rate, turbidity, total suspended solids (TSS), salinity, pH and dissolved oxygen.

Sample Preparation

Hard coral preparation was done through the following steps: sample was put in the oven to be dried at a temperature of 105^0C for 2 days. Samples were then weighed and the weight by 5g was put into porcelain dish and was added HNO_3 and H_2SO_4, respectively $5ml^{-1}$. After the sample was cooled and then dissolved the sample in distilled water and then filtered using filter paper as much as 50ml. Samples to red in glass bottles are subsequently measured their metal concentrations using Atomic Absorption Spectrophotometer (flame, 6200 Shimadzu) (Denton and Burdon-Jones, 1986).

Bioaccumulation is a process in which a chemical substance is absorbed within an organism by all routes of exposure as occurs in the natural environment, i.e., ambient environment sources. Calculation Bioaccumulation Factor (BAF) of hard coral *Porites lutea* used the following equation (Arnot and Gobas, 2006):

$$BAFw = \frac{[heavy\ metal]coral}{[heavy\ metal]water} \quad \text{and}$$

$$BAFs = \frac{[heavy\ metal]coral}{[heavy\ metal]sediment}$$

The statistical analyses of hard coral in the studied localities were made using the one-wayANOVA and LSD method using SPSS (Ver. 16).

RESULTS AND DISCUSSION

Conditions of field parameters in Laelae, Bonebatang, and Badi Islands waters were shown in Table 1.

Table1. Conditions of field parameters in Laelae, Bonebatang, and Badi Islands waters

Parameters	Unit	Laelae	Bonebatang	Badi
Temperature	oC	29±0.0	28.6±0.3	28.17±0.21
Salinity	ppt	34.33±0.58	33.66±0.58	34.33±1.53
Turbidity	NTU	1.51±0,15	0.22±0.14	0.38±0.24
Total Suspended Solid	ppm	108.12±54.7	65.0±17.2	66.18±8.19
pH	-	7.15±0.05	7.15±0.01	7.20±0.02
Dissolved Oxygen	ppm	4.49±0.53	5.01±0.08	6.18±0.16

Table 1shows that the salinity, temperature, pH, turbidity, dissolved oxygen to support life of the coral, no differences at each location, but the Total Suspended Solid and dissolved oxygen different between location. The high value of Total

Suspended Solid because the waters around the mouth of the river there are Tallo, Maros,and Pangkep rivers.

Table 2. Heavy metals content in Laelae, Bonebatang and Badi Islands waters

Metals (mgL^{-1})	Laelae	Bonebatang	Badi
Pb	0.315±0.058	0.245±0.036	0.229±0.051
Cd	0.078±0.001	0.075±0.002	0.079±0.002
Cu	0.032±0.001	0.020±0.001	0.016±0.002

Table 2 shows that the concentration of heavy metals Pb, Cd and Cu in seawater is different at three location. The high concentrations of Pb, Cd and Cu in waters of Laelae Island because it is located near the mainland, so that under the influence of heavy metal input from land.

Tabel 3. Concentration of heavy metals Pb, Cd and Cu in sediment of Laelae, Bonebatang and Badi Islands

Metals (µg.g-^{1}d.wt)	Laelae	Bonebatang	Badi
Pb	17.33±1,34	16.58±0,49	18.32±2,06
Cd	0.22±0,08	0.25±0,04	0.27±0,02
Cu	0.43±0,16	0.24±0,03	0.31±0,22

Table 3 shows that the concentration of heavy metals Pb, Cd and Cu in sediment quality is below the standard (IADC/CEDA. 1997). Lead concentrations in the coral skeletons were similar to that of the sediments obtained by Morrison et al (2001). Other possible sources of Pb in the marine environment could be from industrial discharge, agricultural runoff or from urban/storm water runoff and transportation.Results of the measurement of the concentration of heavy metals Pb, Cd and Cu in the skeleton of hard coral Porites lutea at each observation station are shown in Table 4.

Table 4. Concentration of heavy metals in hard coral *Porites lutea* in Laelae, Bonebatang and Badi Islands

Metals (µg.g-1 d.wt)	Laelae	Bonebatang	Badi
Pb	102.37±21.09	72.85±24.22	79.42±17.20
Cd	1.33±0.63	1.23±0.30	1.31±0.14
Cu	2.04±0.57	2.43±1.46	2.75±0.33

Table 4 shows that in skeleton of hard coral *Porites lutea* contained heavy metals. ANOVA test results to the accumulation of heavy metals in the order Pb hard coral *Porites lutea* showed significant differences between site for heavy metal Pb ($P < 0.05$), while for heavy metals Cu and Cd were not significantly different ($P > .05$). Thus the hard coral *Porites lutea* able to accumulate heavy metals Pb 72-102 ppm, greater than Cd and Cu in skeletal and Pb heavy metal accumulation by hard coral *Porites lutea* highest found on the island Laelae. Anu *et al*. (2007), found hard coral accumulated heavy metal Pb 4.50–24.18 ppm; Shah (2008) found Pb concentrations range from 2.07 to 23.1 ppm and Muhammed and Dar (2010) found 2.91–12.68 ppm.These data demonstrate that the accumulation of heavy metals Pb by hard coral *Porites lutea* in the Laelae Island water greater than in other countries.

Bioaccumulation Factor (BAF) is used to determine the ability of an organism to accumulate in the body element of the surrounding environment. Hard coral *Porites lutea* is a species that lives macrozoobenthos settled at the bottom of the ocean waters. *Porites lutea* able to adapt to the environment so that it can absorb pollutants. Figure 2 shows the calculation of BAF several types of heavy metals by hard coral *Porites lutea*.

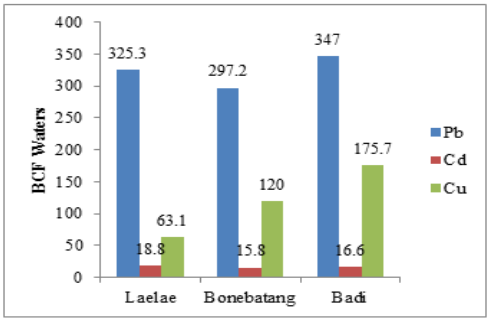

Figure 2. BCFs value heavy metals from waters by hard coral *Porites lutea*

Figure 2 shows the accumulation of heavy metals by hard coral *Porites lutea* from the waters. Pb accumulated ranged from 297.2 to 347 times the concentration in the waters. Further Cu ranged from 63.1 to 175.7 times, ranging from 15.8 to 18.8 times the metal Cd. Thus proving that the hard coral *Porites lutea* as bioaccumulator considerable heavy metal from water. BAFs calculation results of heavy metals from sediments (Figure 3) shows that *Porites lutea* accumulate 4-10 times in sediment. This is very small amount heavy metals accumulated from sediment

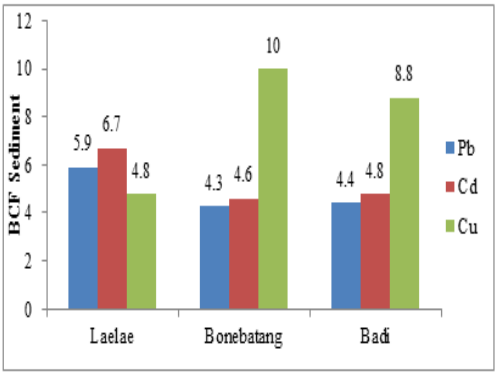

Figure 3. BCFs value heavy metals from sediment by hard coral *Porites lutea*

CONCLUSION

Consentration of Pb in waters and sediment was higher than Cd and Cu, while metals consentration was not different among island waters. The levels of heavy metals in the skeleton of hard coral *Porites lutea* in Laelae Island was higher than Bonebatang and Badi island waters. Based on the value of BAF, metal accumulation derived from water. Suspended material inhibits the accumulation of metals from waters

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