Using the Lime Skeleton of Hard Coral Porites lutea for Monitoring Heavy Metal Pollution of Pb, Cd, Cu and Hg in Spermonde Archipelago

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Using the Lime Skeleton of Hard Coral *Porites lutea* for Monitoring Heavy Metal Pollution of Pb, Cd, Cu and Hg in Spermonde Archipelago

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ABSTRACT

The growth of hard coral *Porites lutea* is characterized by the formation of its lime skeleton. This incident assists the precipitation of contaminant elements into the skeleton. Hard coral has annual cycle, which can be used to provide information of heavy metal pollution in marine waters at a certain time. The purpose of this study was to determine the heavy metal pollution of Pb, Cd, Cu and Hg in five-year period using the skeleton of *Porites lutea* at different waters of Spermonde islands. This study gained a field survey to take samples of *Porites lutea*. Oceanographic parameters were measured, as well as heavy metals in water, in order to ring their accumulation. The oceanographic parameters of temperature, salinity, turbidity, pH and dissolved oxygen corresponds to coral life, while the Total Suspended Solid and heavy metals in the waters were very high. The results show different concentrations of heavy metals in the ring lime skeleton of *Porites lutea* in the past 15 years.

Keywords*:* *Porites lutea*, lime skeleton, heavy metals pollution, Spermonde Archipelago

INTRODUCTION

Heavy metal pollution in marine waters has increased from year to year, specifically on certain elements such as mercury (Hg), cadmium (Cd), lead (Pb), copper (Cu) and zinc (Zn). These elements have strong (high) toxicity, and can lead to reduce the sea water quality as well as poison the marine organisms. The toxicity of heavy metals depends on type, concentration, synergistic-antagonistic effects and physico-chemical properties (Darmono. 2001).

Some ways has been carried out to monitor marine pollution by using marine organisms that has ability to accumulate heavy metals in their bodies. Some plant species such as seaweeds, seagrass and animal species like shellfishes are able to accumulate heavy metals. Sponge is one type of marine organisms that can accumulate heavy metals. Van Hansen et al. (2000) reported the marine sponge *Halichondria panicea* as a cosmopolitan species was capable to accumulate heavy metals of Cu. Zn and Cd. Similarly, Cebrian et al. (2003) observed the sponge *Crambe crambe* accumulated copper, tin and vanadium. Later on Samawi et al. (2010) also revealed the ability of some types of marine sponges in accumulating heavy metals of Pb, Cd and Cu from the waters of Makassar city. Hence, this generates the existence of heavy metal pollution by using other phyla of marine animals. In this study, the use of hard coral *Porites lutea* in accumulating heavy metals from waters with different conditions is carried out to reveal the metal pollution in some previous years.

MATERIALS AND METHODS

Study Site

Sampling of hard coral *Porites lutea* was conducted in June to September 2012, from the waters of Lae-lae, Bonetambung and Badi islands (Figure 1). The sites represents on three category: (1) close to mainland, (2) far from mainland, and (3) far from mainland but without population. Sample preparation of hard coral was done in Laboratory of Chemical Oceanography, Faculty of Marine Science and Fisheries

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Hasanuddin University. Levels of heavy metals were measured in the Laboratory of Environmental Health Makassar.

Figure 1. Sampling locations of hard coral *Porites lutea* in three islands of Spermonde Archipelago.

Sampling and Environmental Data

Hard coral samples were taken out by SCUBA diving, then transported to the laboratory for analysis of heavy metal content of Pb, Cd, Cu, Hg. The water samples were carried out by using plastic bottles for analysis of heavy metal content of Pb, Cd, Cu, Hg and total suspended solids (TSS). The sediment samples were carried out by using plastic pipe, for analysis of metal content of Pb, Cd, Cu, and Hg. Water temperature and pH was measured using pH meter, and salinity on each site was using an analogue refractometer. Dissolved oxygen and turbidity were measured at each site using water quality checker.

Sampel Preparation and Analytical Method

Hard coral samples were cut approximately 1 cm with a rock saw along the maximum growth axis. Coral slabs were cleaned with distilled water in an ultrasonic bath for 20 min and dried in an oven at 60°C for 48 h. Each slab was X-rayed along the best line of annual growth bands that revealed high- and low-density bands on the X-radiographs (Figure 2). About 5 g was picked out for heavy metal analysis. Coral samples mashed into a powder and add HNO_3 and H_2SO_4 respectively 5 mL. After the sample was cooled, it was dissolving in distilled water and then filtered using filter paper as much as 50 mL. Samples stored in plastic bottles for subsequently measured metal concentrations using Atomic Absorption Spectrophotometer (flame, Shimadzu 6200).

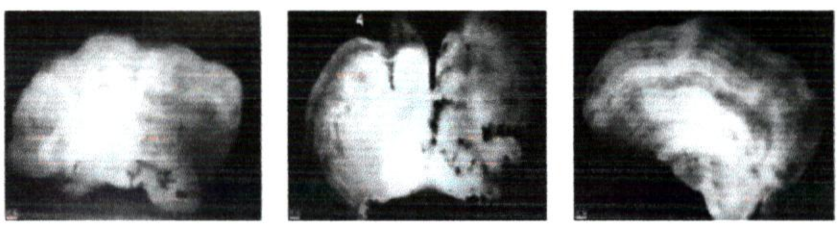

Figure 2. X-Ray of coral *Porites lutea* slabs

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RESULTS AND DISCUSSION

Enviromental Variables

Environmental variables condition showed that high scores of turbidity and TSS were found on the Laelae rather than in Bonebatang and Badi (Table 1). This high value of turbidity and TSS was figured out since the waters of Lae-lae located nearby to the mouth of the Tallo River.

The Table 2 shows that the concentration of heavy metals Pb and Cu in water were higher in Lae-lae waters. This high concentrations of Pb and Cu was due to the island's location which near to the mainland. Meanwhile, the results of concentration of heavy metals Pb, Cd, Cu and Hg in the hard coral *Porites lutea* in the span of 15 years with a 5-year period of observation at each site are shown in Figure 3.

Table 1. Environmental variables (mean ± SE) in Lae-lae, Bonebatang and Badi islands.

Parameter	Unit	Lae-lae	Bonebatang	Badi
Salinity	ppt	34.33±0.58	33.66±0.58	34.33±1.53
Temperature	°C	29.00±0.00	28.60±0.30	28.17±0.21
pH	-	7.15±0.05	7.15±0.01	7.20±0.02
Turbidity	NTU	1.51±0.15	0.22±0.14	0.38±0.24
Oxygen	mg/L	4.49±0.53	5.01±0.08	6.18±0.16
TSS	mg/L	108.12±54.70	65.00±17.20	66.18±8.19

Table 2. Heavy metal content of Pb, Cd, Cu and Hg (mean ± SE) in Lae-lae, Bonebatang and Badi waters.

Parameter	Unit	Lae-lae	Bonebatang	Badi
Pb	mg/L	0.315±0.014	0.245±0.044	0.229±0.009
Cd	mg/L	0.078±0.010	0.075±0.004	0.079±0.008
Cu	mg/L	0.032±0.016	0.020±0.005	0.016±0.000
Hg	mg/L	2.382±0.890	3.632±0.568	0.016±0.000

Figure 3a shows that the heavy metals Pb accumulated by the hard coral *Porites lutea* was different in each site. On Lae-lae coral samples showed a pattern that tends to increase, while in Bonebatang and Badi tends to decrease. ANOVA results gave a significant differences ($P<0.05$) concentrations of Pb accumulation in hard coral *Porites lutea* in 2012. Another heavy metal accumulation of Cd from 1997-2002 to 2002-2007 showed an increase in all sites, but later in 2002-2007 to 2007-2012 in the concentration in Lae-lae sample still increases, while in Bonebatang and Badi tend to decrease (Figure 3b).

The accumulation of heavy metals Cu in the hard coral *Porites lutea* in 1997-2002 to 2002-2007 in Lae-lae and Bonebatang samples temporary increase, while Badi samples tend to decreased. In contrast to 2002-2007 to 2007-2012, coral samples of Lae-lae and Bonebatang decreased, but Badi's samples increased (Figure 3c).

The accumulation of Hg in hard coral *Porites lutea* in the year of 1997-2002 to 2002 2007 in all sites shows a decrease accumulation (Figure 3d). In contrast to the year of 2002-2007 to 2007-2012 in which all sites also give an increase figure. However, the accumulation of heavy metal Hg was highest in Badi Island.

The accumulation of heavy metals in the framework of hard coral *Porites lutea* greatly influenced by the surrounding environment. This influences were determined by ng Principal Component Analysis which explains how the character of environment affects the accumulation of heavy metals in the context of hard coral *Porites lutea*.

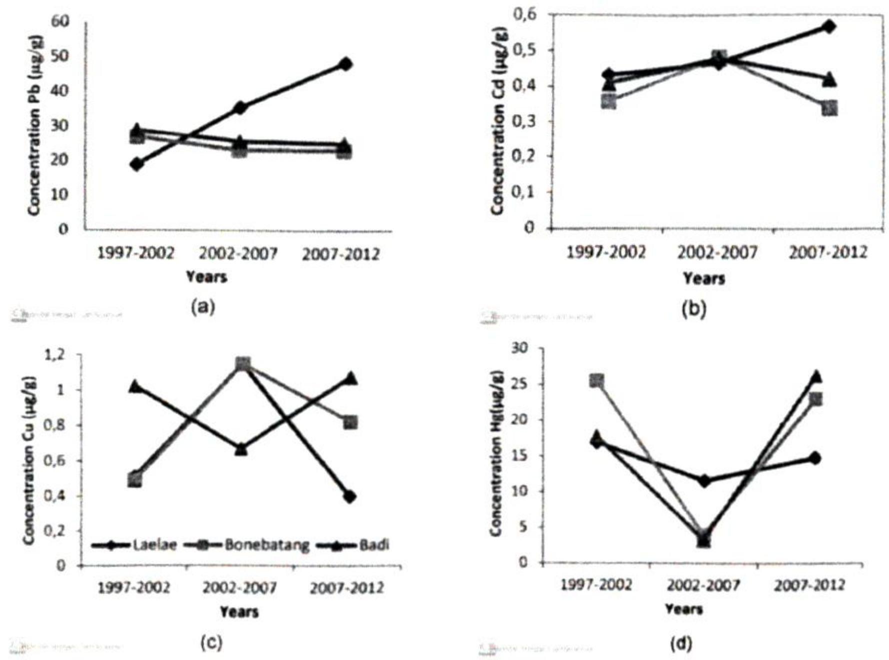

Figure 3. Concentration of (a) Pb, (b) Cd, (c) Cu and (d) Hg in the 5-year period in hard corals Porites lutea.

CONCLUSION

The hard coral *Porites lutea* can be used to reveal the heavy metal concentration differences Pb, Cd, Cu and Hg over a period of 15 years. Accumulation of heavy metals is strongly influenced by the nature of the metal itself and oceanographic parameters. Thus the hard coral *Porites lutea* can be used to monitor changes in the level of heavy metal pollution in water bodies.

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