Essential Metal Co In Sponges (Porifera) From Spermonde Archipelago

Lydia Melawat, Kristiana Pasau

ABSTRACT: Sponge is an invertebrate animal commonly found in Spermonde Archipelago. It is known as an animal living as filter feeder. Sponge is capable of accumulating heavy metals including cobalt (Co). Co is an essential metal in low concentration but a pollutant in high concentration. Sponges used in this study were Melophlus sarassinorum, Callyspongia aerizusa, and Clathria reinwardtii. Sponges were analyzed based on modified Muller et al (1998) method. Co concentrations were determined using ICP-OES. Co metal in three sponge species from seven different islands indicated equal concentration (2 mg/kg) except for the sponge Callyspongia aerizusa from Lae-Lae and Barrang Caddi islands that accumulated lower Co (0.5 mg/kg).

Keywords: filter feeder, heavy metal, ICP-OES.

1. INTRODUCTION

The centralization of population, tourisms and industries in coastal region has contributed significantly to marine environment pollution. Pollution in coastal and marine environment is commonly resulted from activities in land such as industrial, agricultural, domestic wastes disposal, coastal area reclamation, and marine activities such as sailing, oil exploration and exploitation, sea and fishery cultivations [1]. The wastes from Makassar city are disposed through city channels and rivers ended in estuary. Majority of the wastes are derived from people activities either in households, hotels, restaurants, agriculture, or home industries located in the surrounding areas of rivers/channels or in coast or sea vicinity. These wastes contain heavy metals that cause accumulation in waters environment, marine biotas, and marine sediments in Spermonde Archipelago [2]. Sponges which are filter feeder animals can be exposed to those metals due to their feeding pattern that filter seawater through pores on their body surfaces and living in coral reef ecosystems [3]. Moderate pollutant level does not seem harmful to mature invertebrates but negatively affect the physiology of invertebrate larva and juveniles [4, 5]. Among the heavy metals polluting the Mediterranean coastal regions, some have contrast effect in early life stage, depending on metal concentration and exposure time [6]. Environmental factors such as pH, temperature, and salinity determine the chemical and physical form of the heavy metals in marine ecosystem. The form of a metal can change with the alteration of these factors, which in turn can influence the availability, accumulation, and toxicity of heavy metals. Interaction between trace metals and biota affects not only the metal and its form, but also the organisms through accumulation level, biological processes inhibition, nutrient cycle reversal, reduced biota distribution, and lethal and sub-lethal toxic response [7].

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2. MATERIALS AND METHOD

2.1 Materials

Sponge of Melophlus sarassinorum, Callyspongia aerizusa and Clathria reinwardti types, HNO3 p.a, aquadest, aquabidest, Whatman filter paper no. 42, acetone, MIBK, and APDC.

2.2 Apparatus

Oven, electric stove, sea water, glassware, vacuum pump, Buchner funnel, separating funnel,and ICP-OES instrument.

2.3 Sampling

Sponge, sea waters, and sediment samples were collected by diving in certain depth using SCUBA diving set.

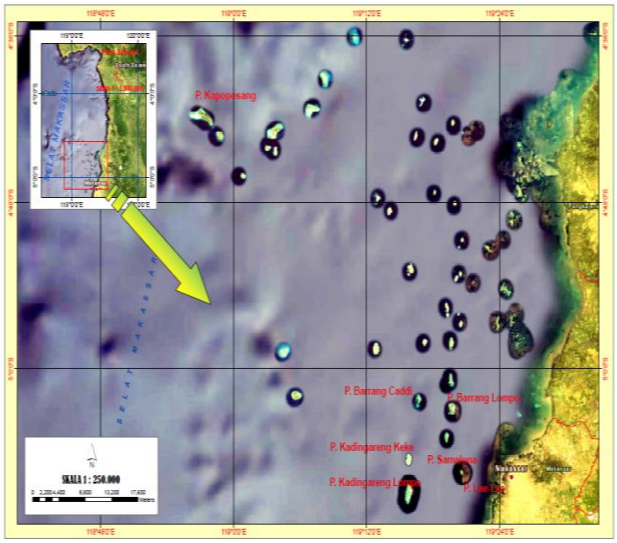

Figure 1. The Map of sampling location in Spermonde Archipelago

2.4 Experimental procedures Determination of essential metal Fe in sponge [8]:

Each of the sponge samples was divided into two parts: 1 part for treatment in skeleton and 1 part for total treatment. The dry sample of the sponge was weighted 0.5 g carefully in beaker glass, and then was added with 5 mL nitric acid and heated at 150^{o}C for 2 hours. After cooling at room temperature, sample were added into measuring flask 25 mL and its volume was rounded with aquabidest and shaken until homogeneous. The

solution was filtered using Whatman filter paper and ready for analysis with ICP-OES.

3. RESULTS AND DISCUSSION

Analysis results of heavy metal Co in sponges can be seen from Figure 2. From the three sponge species studied, Callyspongia aerizusa from Lae-Lae and Barrang Caddi islands accumulated lower Co (0.5 mg/kg). Whereas Melophlus sarassinorum and Clathria reinwardtii accumulated Co in same concentration (2 mg/kg). The three sponges from Samalona, Barrang Lompo, Kodingareng Lompo, Kodingareng Keke, and Kapoposang islands accumulated Co also in same concentration (2 mg/kg). This was suggested due to the small Co concentration available in seawater. In addition, it has been established that the deeper the seawater, the smaller the Co concentration [9]. In seawater Co can occur as Co(II) or Co(III) in natural pH reach (pH 6-7). In the form of Co^{2+}, Co is a strong divalent cation but labile in organic complex. Co(III) is the inert or oxide complex. Co(II) has electron configuration of low spin d^7, with one single electron. This configuration makes Co(II) very reactive [10], easily oxidized into inert or oxide complex Co(III). Co(III) is the most stabile form in water because it thermodynamically bind to oxygen in seawater, and Co concentrated in water column are probably due to oxidation of soluble Co(II) into reactive particle or inert Co(III) in surface [9].

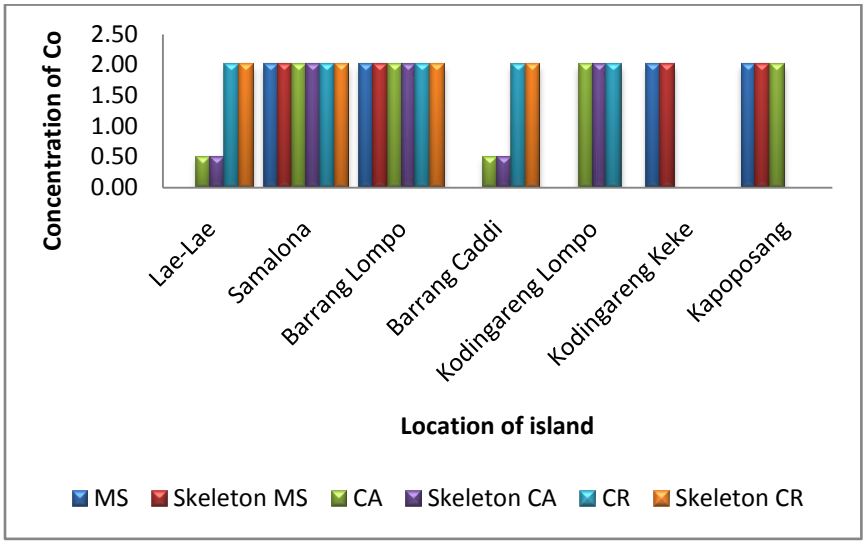

Figure2. Co concentration in sponge bodyand skeleton (mg/kg)

MS : Melophlus sarassinorum
CA : Callyspongia aerizusa
CR : Clathria reinwardtii

Relationship between location and concentration of Co with environmental parameters was analyzed by PCA (Figure 3). Analysis results indicate 2 groups in main axis that can explain 72.6% observed variation. Group 1 was represented by Samalona and Barrang Lompo where Co concentration in the three sponge species was affected by pH, temperature, and current velocity.Group 2 was represented by Kapoposang and Kodingareng Keke where Co concentration in sponge was affected by high salinity. This indicates that environmental parameters affect the Co accumulation in sponge.

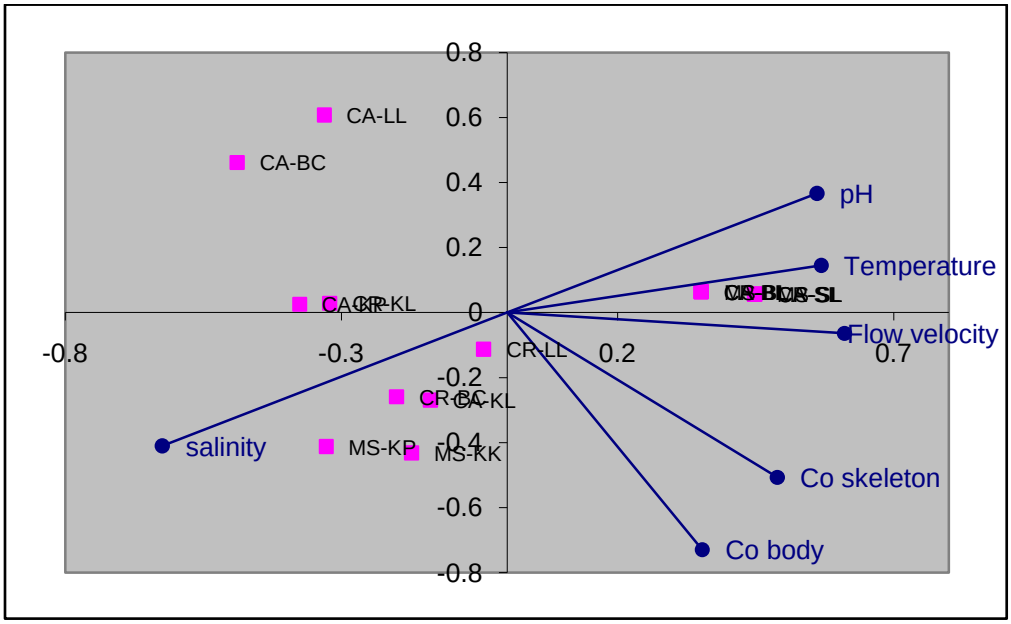

Figure 3. Relationship between location and concentration of Co with environmental parameters

4. CONCLUSIONS

1. Concentration Co in sponges (Porifera) from Spermonde Archipelago, the lowest Co concentration is 0.5 mg/kg and the highest is 2 mg/kg.
2. Sponge Melophlus sarassinorum, Callyspongia aerizusa, andClathria reinwardtiihave equal ability as Co heavy metal zooremediator.

5. ACKNOWLEDGEMENTS

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6. REFERENCES

[1] Rachmat, R. and Murniasih, T. 2001. Identification of Sterol Compound in Aaptos sp. from Spermonde. Proceedings of National Conference IV. Chemistry in Development. Yogyakarta, 27 – 28 Maret 2001.

[2] Melawaty, L., Noor, A., Harlim, T., and Voogd, N. de. 2012. Distribution ofEssential Metal Cu in Sponges (Porifera) from Spermonde Archipelago. Marina Chimica Acta 13 (2):27-32.

[3] Carballo, J.L and Naranjo, S. 2002. Environmental Assessment of a Large Industrial Marine Complex Based on a Community of Benthic Filter Feeders. Mar. Poll. Bull. 44. 605-610.

[4] Rinkevich, B. and Loya, Y., 1977. Harmful effects of chronic oil pollution on a Red Sea Scleractinian Coral population. Proc. 3rd Int. Coral Reef Symposium, Miami, Florida, pp. 585–591.

[5] His, E., Geffard, O., and DeMontaudouin, X., 1999. A comparison between oyster (Crassostrea gigas) and sea urchin (Paracentrotus lividus) larval bioassays for toxicological studies. Water. Res. 33 (7), 1706–1718.

[6] Cebrian, E. and Uriz, M.J. 2007. Do Heavy Metals Play an Active Role in Spons Cell Behaviour in The Absence of Calcium? Consequences in Larval Settlement. J. of Exp. Mar. Bio. and Eco. 346, 60-65.

[7] Connell, D.W. and Miller, G.J. (1995). Kimia dan Ekotoksikologi Pencemaran. Terjemahan oleh Yanti R. H. Koestoer.Jakarta .UI-Press.

[8] Müller, W. E. G., Batel, R., Lacorn, M., Steinhart, H., Simat, T., Lauenroth, S., Hassanein, H., dan Schrőder, H. C. 1998.Accumulation of cadmium and zinc in the marinespons Suberites domuncula and its potentialconsequences on single-strand breaks and onexpression of heat-shock protein: a natural field study. Mar. Ecol. Prog. Ser. 167 : 127-135.

[9] Moffett, J. W. and Ho, J. 1996. Oxidation of Cobalt and Manganese in Seawater Via A Common Microbially Catalyzed Pathway. Geo et Cosmo Act. 18: 3415-3424.

[10] Kaim, W. and Schwederski, B. 1994. Bioinorganic Chemistry : Inorganic Elements in The Chemistry of Life. John Wiley & Sons Ltd : England.