JoSSED 2(1) (2021)

Journal of Science and Science Education

http://jppipa.unram.ac.id/index.php/jossed/index

Analysis of Cadmium (Cd) and Lead (Pb) Heavy Metal Content in Shell and Mangroves at Bima Bay

K. Khairuddin[1]*, M. Yamin[1]

[1] Biology Education Study Program, FKIP, University of Mataram, Mataram, Lombok Island, West Nusa Tenggara Indonesia

DOI: 10.29303/jossed.v2i1.726

Article Info
Received : March 22th, 2021
Revised : April 28th, 2021
Accepted: April 30th, 2021

Abstract: This study aims to determine the levels of heavy metals (Cd) and (Pb) in shellfishes and mangroves at Bima bay. The results showed that bivalves and mangrove tissue were analyzed for heavy metal content in the form of lead (Pb), and Cadmium (Cd) using an Atomic Absorption Spectrophotometer. From tissue analysis, it indicates that the content of heavy metals lead (Pb) in 3 species of Shellfish which showed different results; Blood shells (Anadaragranosa) of 0.756 ppm, Hiatula shells (*Hiatula chinensis*) 1.59 ppm, and Shells (*Siliqua winteriana*) 1.171 ppm. Cadmium (Cd) metals in Shells are each found; Cockle shell (*Anadara granosa*) of 0.802 ppm, Hiatula shells (*Hiatula chinensis*) 0.334 ppm and Shells (*Siliqua winteriana*) 0.066 ppm. The content of lead metal (Pb) in the tissue of small mangrove leaves *(Ryzophora apiculata*) is 3.21 ppm and the mangrove leaves (*Sonnerati aalba*) is 3.74 ppm. For Cd levels in small mangrove leaves (*Ryzophora apiculata*) is 0.41 ppm while in mangrove leaves (*Sonneratia alba*) is 0.24 ppm.

Keywords: Heavy metal; Cadmium; Lead; Shellfish; Mangrove

Citation: Khairuddin, K., & Yamin, M. (2021). Analysis of Cadmium (Cd) and Lead (Pb) Heavy Metal Content in Shell and Mangroves at Bima Bay. *Journal of Science and Science Education, 2*(1), 58-61. doi:https://doi.org/10.29303/jossed.v2i1.726

Introduction

Bima Bay is a bay that is used by the community for business activities such as fish ponds, fisheries, tourism and water transport activities. Milkfish ponds have been running for a long time and use various types of medicines to poison pests and fertilizers to fertilize pond waters. Sea water can be easily contaminated by various heavy metals such as mercury (Hg), lead (Pb), and cadmium (Cd) (Widowati, et.al, 2008). Water pollution can come from garbage, liquid waste and other pollutants such as fertilizers and pesticides. Many foods are also derived from seafood such as fish, shrimp, squid and so on. Many foods circulating in the community are contaminated with heavy metals such as lead (Pb), mercury Hg), arsenic (As) and cadmium (Cd). These metals come to human's body through food, which can disrupt the nervous system, brain damage, and cancer (Agustina, 2010; Alina, et.al, 2012; Rahmawati et.al, 2015).

There are several riverswhich flow into the Bima bay such as the Palibelo River, the river from Bolo and from the Woha District. It receives water masses and sediments from agricultural areas in the Palibelo sub-district, Belo sub-district, Woha sub-district and Bolo sub-district. It also receives water and sediment from the Padolo river and other rivers in the City of Bima. Many of the pollution that have been studied particularly in the bays as previous research have reported that the levels of heavy metals/pollutants in

Email: khairuddin.fkip@unram.ac.id (*Corresponding Author)

sea water a sediment in the Cisadane river showed that the levels of heavy metals (Pb, and Cd,) in sea water in estuarine waters ranged from Pb ≤ 0.001 to 0.005 ppm, and Cd ≤ 0.001 to 0.001 ppm. The results of the study (Amriani, et.al, 2011), found the levels of Pb in the **C**ockle shell tissue (*Anadara granosa*) in Kendari bay amounted to 1.703 mg/kg tissue weight, and this had exceeded the quality standard. Other data indicated that the waters of the eastern bay of Jakarta have been contaminated by Cu, Ni and Cd metals (Rochyatun, and Rozak, 2007).

The habit of farmers who use anti-pest drugs and excessive fertilizer will leave residue in the soil and water as happened in the Bima bay. Pollutants can be accumulated by animals that live in sediments such as bivalves and mangrove plants. For this reason, a research was carried out to determine the content of pollutant metals in bivalve and mangrove networks. Thus, the purpose of this study is to find out the content of pollutant metals (Pb, and Cd) in the Bivalvia class (Bivalvia tissue) and mangrove leaf tissue from the Bima bay. The result of this research is in the form of information or data on the content of pollutant metals in the Bivalvia class and the mangrove leaf tissue oat Bima bay. This result will be able to be used to enrich the subject matter of Environmental Knowledge and Ecotoxicology courses.

Method

This research is based on topographic considerations, which are divided into 3 stations representing area in Bima bay. Data were collected by using manual method or Shells traps for various types of Shells such as **C**ockle shell (*Anadara granosa*), Shellfish (*Siliqua winteriana*), and Hiatula Shells (*Hiatula chinensis*) from the bivalvia class. Samples of **C**ockle shell (*Anadara granosa*) and other shells are taken at low tide using hand or tongs. Then, it randomly taken for about 10-20 bivalve shells at each sampling location from three sampling points. The sample of the shells was put in a plastic bag and then stored in an ice box. For mangrove data taken using a manual method or cutting tool for each species of Mangrove leaf (*Sonneratia alba*) and small mangrove (*Ryzophora apiculata*) where they take at 2 research locations in Palibelo and Amahami. The research sample, then be analyzed at the Analytical Chemistry Laboratory in University of Mataram.

Data analysis was done by analyzing the content of bivalve and mangrove leaf tissue which were analyzed for heavy metal content in the form of lead (Pb), and Cadmium (Cd) using the Atomic Absorption Spectrophotometer (AAS). Heavy metal content measured in bivalve tissue and mangrove leaves is done by adding concentrated HNO_3 and $HClO_4$, then heated at a temperature of 60-70^oC for 2-3 hours until the solution was clear. The sample was ready to be measured by AAS using an air-acetylene flame.

Result and Discussion

Research data on the Pb and Cd weight metal content in bivalve shell tissue and mangrove leaf tissue from the Bima bay can be seen in Figure 1.

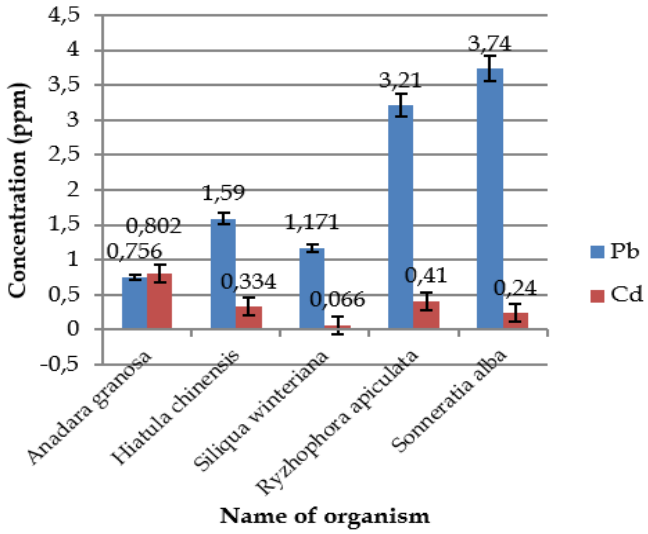

Figure 1. Pb and Cd levels in various organism in Bima bay

Heavy metals lead (Pb), and Cadmium (Cd) are found in all species of shells and mangroves, such as in **C**ockle shell (*Anadara granosa*), shells (*Siliqua winteriana*), hiatula shells (*Hiatula chinensis*), mangroves (*Sonneratia alba*) and small mangrove (*Ryzophora apiculata*). From the figure 1, lead metals (Pb) in Shells are found in the following level: **C**ockle shell (*Anadara granosa*) of 0.756 ppm, Hiatula shells (*Hiatula chinensis*) 1.59 ppm, and Shells (*Siliqua winteriana*) 1.171 ppm, *Sonneratia alba* 3.74 ppm and *Ryzophora apiculata* 3.21 ppm. Cadmium (Cd) metals in Shells are each found; **C**ockle shell (*Anadara granosa*) of 0.802 ppm, Hiatula shells (*Hiatula chinensis*) 0.334 ppm and Shells (*Siliqua winteriana*) 0.066 ppm. While the heavy metal Cd in *Sonneratia alba* is 0.24 ppm and in *Ryzophora apiculata* 0.41 ppm.

Moreover, heavy metals in general can be toxic substances that poison the bodies of living things (Gomez, et.al, 2018). There are several types of heavy metals such as mercury (Hg) or commonly called mercury and lead (Pb). Both of these metals are commonly found in bodies of water such as bays, river mouths and canals such as canals in the Hartasning area of Makassar city (Wanna, et.al, 2017). The presence of heavy metals entering the Bima bay which is marked

by the presence of Pb and Cd in the bivalve and mangrove tissues showed that the bay has experienced heavy metal pollution. Heavy metals such as Pb and also Cd can indeed enter the river mouth waters such as the Banyuasin river, generally derived from anthropogenic activities which are industrial activities, fuel, household (domestic) and agriculture. For example, cadmium concentrations in sediments and in surface water in the estuaries of the Banyuasin River range between 0.008-0.062 mg/l, and ranging from 0.002-0.062 mg/l (Barus, 2017). Metals are found in many bays as well as in the Ambon bay. The metal concentrations found in the marine sediment of Ambon Bay can be related to discharge from urban waste and industrial activities around the bay. Marine surface sediment of Ambon Bay has been contaminated by heavy metals Fe, Cu, Zn, Pb, C and Hg (Manullang, et.al, 2017).

Furthermore, the heavy metal content in the Bima bay can occur due to the activities of farmers who use fertilizer, because fertilizer also contains Cd. The content of heavy metal cadmium (Cd) was also detected on average 0.025 - 0.075 mg/liter in the Porong river (Rachmawatie, et.al, 2009). The results of the concentration analysis of cadmium metal (Cd) in sediments also showed varying values at each time. The results of the measurement and analysis of lead content (Pb) in sediments sequentially at the Tuban, Gresik and Sampang sampling locations have an average of 2.9443 ± 0.3608 mg/kg, 3.3687 ± 0.5257 mg/kg, 3.4253 ± 0.3697 mg/kg, Cadmium (Cd) metal content in Tuban waters 2.978 ± 0.224 mg/kg, Gresik 2.955 ± 0.179 mg/kg, Sampang 3.012 ± 0.148 mg/kg (Syaifullah, et.al, 2018). The content of heavy metals Hg and Cd in sediments and water in Morodemak, East Flood Canal and Mangkang as research field indicated similar accumulationof the heavy metal content. The heavy metal content of Hg and Cd in *Anadara granossa* shells showed varied values, due to the influence of heavy metal content in water and sediment media (Wulandari, et.al, 2009). Pb did not only accumulate in shellfish, but also in fish. Pb content in tilapia meat ranged from 0.146 ppm to 0.174 ppm (Mahalina, et.al, 2016). Baung is a fish that likes to search for food in the seabed and eat young fish, shrimp mussels, insecta, molluscs and grass types that have accumulated mercury (Hg), lead (Pb) and cadmium (Cd). The process of heavy metals comes to fish's can be through the food chain system, gills and diffusion of the skin so it requires a long and gradual time for the fish's body to be declared contaminated with heavy metals. Heavy metals have found around Hg of 0.09 mg/kg and Cd> 0.01 mg/kg in Baung fish and Hg of 0.007 mg/kg and Cd>0.005 mg/kg in Kahayang river water (Budiarti, et.al, 2008). One sample showed a level of Cd close to the allowed limit (1.11 ± 0.21 mg/kg of wet weight) in Bivalves Molluscs of Apulian Region (Miedico, et,al, 2013).

Hence, bone is main organ target of Cd so that it is seriously damaged, whilst, Pb's target organs are the nervous system, kidney system, reproductive system, endocrine system and heart. Every part that is attacked shows different effects. Poisoning will be more if contamination coincides with Hg metal because mercury can cause nerve damage in the brain, disruption of kidney and liver function, and damage the fetus in pregnant women (Widodo, 2008). Cd can damage bones. Ingestion of Cd is associated with human skeletal damage and reproductive deficiencies, and foodstuffs are the main sources of this metal. The presence of high levels of Cd is often associated with human activity such as being industrial fertilizers and sewage sludge (Khairuddin, et. al, 2018 a).

Around the Bima bay there are also agricultural activities, settlements, ponds, stevedoring activities at the port and flight activities. The existence of industrial activities is likely to produce heavy metal waste (Khairuddin, et. al, 2018 b). Heavy metals can accumulate in the body of animals and plants (Amriarni, et.al, 2011), therefore, it functions as a bioindicator (Zulfiah, et.al, 2017]. In addition to industrial activities, domestic activities such as shipping activities, public transportation, and fishing vessels can also produce heavy metal waste. Heavy metals are very dangerous for humans and other organisms, because heavy metals have characteristics that are difficult to degrade, easily dissolved in water, deposited in sediments, and can accumulate in the body of aquatic biota. Heavy metals can be absorbed in the body of organisms such as fish and shellfish in two ways: food channel (diet exposure) and the surface of the gills (water exposure). Bivalve fish and shells are part of aquatic biota which are often used as bioindicators of heavy metals in the waters, because fish are included in the highest trophic level and human protein source. If fish that accumulate heavy metals are consumed by humans, then these heavy metals can accumulate in the human's body. Thus, the excessive number of heavy metals can endanger human life (Cahyani, 2018; Khairuddin, et.al, 2021). Foodstuffs that contain heavy metals even though it has a little level of heavy metal content in it, if consumed continuously will tend to be toxic to humans' body (Hidayah, et.al, 2014; Riani, et.al, 2017; Salam et.al, 2019).

Conclusion

Based on the description and discussion, it can be concluded that: The level of lead metals (Pb) in Shells

are **C**ockle shell (*Anadara granosa*) of 0.756 ppm, Hiatula shells (*Hiatula chinensis*) 1.59 ppm, and Shells (*Siliqua winteriana*) 1,171 ppm, in mangrove *Sonneratia alba* 3.74 ppm and *Ryzophora apiculata* 3.21 ppm; Cadmium (Cd) metals in Shells involve **C**ockle shell (*Anadara granosa*) of 0.802 ppm, Hiatula shells (*Hiatulachinensis*) 0.334 ppm and Shells (*Siliqua winteriana*) 0.066 ppm; while the heavy metal Cd in mangrove contains *Sonneratia alba* 0.24 ppm and *Ryzophora apiculata* 0.41 ppm.

Acknowledgements

We would like to thanks go to the Rector of the University of Mataram and his staffs who provided funding and laboratory facilities for data analysis in this study.

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