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Heavy metals (Pb, Cd, Cu and Cr) Accumulation on different shell size of *Polymesoda* sp from Estuary Waters of Parepare Bay

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Abstract. This study revealed the differences in the concentration of heavy metals Pb, Cd Cu and Cr accumulated in different-sized group of *Polymesoda* sp shells originating from the waters of Parepare City. Shellfish were divided into three size groups namely Small (23-41 mm); medium (42-59 mm) and large (59-77 mm). Heavy metal concentrations in shell, water and sediment samples were analyzed using atomic absorption spectrophotometers (AAS). The results showed that the concentration of heavy metals in waters and sediments had the same pattern, Cu > Pb > Cd > Cr. Heavy metals, Pb and Cu, had the highest accumulation in the large-sized shells, while Cd was in the medium-sized shells. Cr however, showed the lowest accumulation in all size groups. This situation shows that *Polymesoda* sp shells originating from the waters of Parepare Bay are still suitable for consumption.

Keyword: *Polymesoda* sp., heavy metal, accumulation, Parepare

INTRODUCTION

Polymesoda sp. is one of the types of shellfish consumed by the coastal communities of South Sulawesi. These shells are easy to grow and breed in estuarine areas, so they are targeted by fishermen. However, these shells are easily exposed to pollutants. Erlani *et al.* (2017) found Shells (*Marcia hiantina*) on the Losari beach, Makassar were contaminated with mercury.

Parepare City is an administrative city located in the coastal area of Parepare Bay. Various activities take place in this city including ports, industry and settlements. These activities have polluted sea waters with various pollutants. While the coastal communities of the city of Parepare consume *Polymesoda* sp mussels as supplementary food originating from estuary areas in the waters of Parepare Bay.

Information regarding heavy metal contamination in *Polymesoda* sp shells in river mouth waters in the City of Parepare is unknown. This is important to maintain the food safety of people who consume these types of shellfish. Several studies have proven that shellfish that live in estuary areas are prone to contamination by pollutants, especially heavy metals. Birch *et al.* (2019) explained that different Cu, Pb and Zn bioconcentration were seen in shellfish tissue (*A. trapezia*), shellfish (*Mytilus galloprovincialis*) and oysters (*Saccostrea glomerata*) in Sydney estuary which might be caused by diet and biogeochemical conditions differ in basic sediments. Anandkumar *et al.* (2019) explained that *Polymesoda erosa* shells accumulate higher Zn metal than Cd metal in gill tissue. Clam *Polymesoda erosa* from the Mandovi estuary, the west coast of India has been studied with Atomic Absorption Spectrophotometry (AAS) accumulating higher Pb metal concentrations compared to Cd (Lata *et al.* 2013).

Research on the accumulation of heavy metals by several *Polymesoda* sp size groups from estuaries in the City of Parepare has been studied with Atomic Absorption Spectrophotometry (AAS) and proves that the size of *Polymesoda* sp shells influences the level and type of heavy metal accumulation

MATERIAL AND METHODS

Site sampling

Sampling of shells, sediment and water in this study was carried out in the waters of Parepare, South Sulawesi (Figure 1). Sample preparation was carried out in the Chemistry Oceanography laboratory at Hasanuddin University.

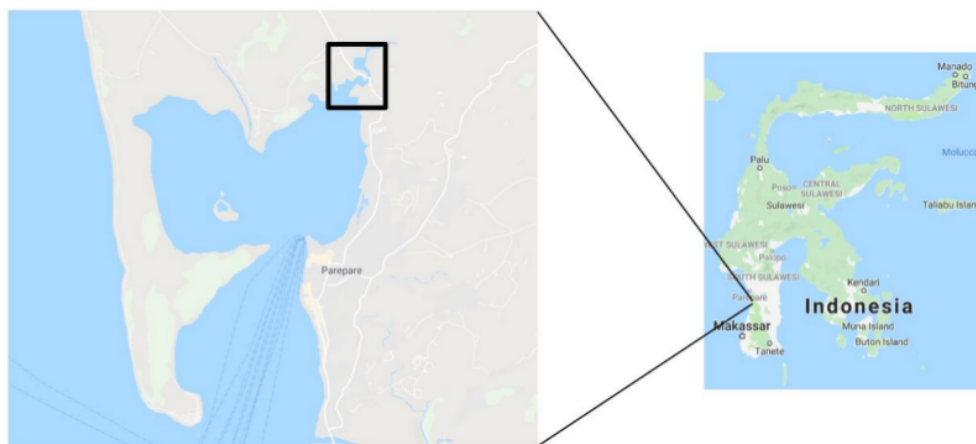


Figure 1. Sampling Site

Procedures

Water samples were taken at the bottom surface of the waters using Nansen bottles. A total of 500 mL of water sample is put into a polyethylene bottle and stored in a cool box then taken to the laboratory for heavy metal content analysis. Water sample preparation, 50 ml of water sample is put into a 100 ml beaker and 5 ml of concentrated HNO_3 is added, covered with a watch glass. Then it is heated slowly until the remaining volume is 15 ml-20 ml. Then the water sample is transferred into a 50 ml volumetric flask and added distilled water until the marking mark is then homogenized. After that, the absorption is read by using AAS (SNI, 2009).

Sediment sampling was carried out using Ekman Dredge as much as 500 g. The total concentration of heavy metal content of Pb, Cd, Cu and Cr in the sediment was determined by extracting sediment by acid destruction using HNO_3 (nitric acid) and HClO_4 (perchloric acid) solvents (SNI 06-06992.8-2004).

Shellfish samples taken amounted to 100 tails, then measured the length of each individual shell and determined the size range of large, medium and small. Furthermore, each shell size group was preparation. Blend the shellfish meat in a blender until it is homogeneous, then placed in a Polystyrene container and closed. Take as much as 5 mg of the sample into a

porcelain cup and record its weight. The sample is put into a furnace at 450°C for 18 hours. After being ash then cooled at room temperature, add 1 mL of 65% HNO₃, heated at 100°C until dry. 5 mL of HCL 6 M was added, then evaporated on a hot plate to dry. Add 10 mL of HNO₃ 0.1 M let stand for 1 hour at room temperature. Then put into a 50 mL Polypropylene measuring flask, measure the metal content using AAS (SNI 2354.5-2011).

The concentration of metals in water, sediments and shellfish was analyzed using Atomic Absorption Spectrophotometer (Hitachi-Z 2000 Tandem Flame / Furnace AAS)

At the time of sampling, measurements were also made of the physical chemistry parameters of the waters including temperature, salinity, pH, and flow of current.

Data Analysis

The data obtained were analyzed descriptively using tables and graphs. Meanwhile, to determine the value of factor bioaccumulation is carried out using the following equation (Hendozko *et al.*, 2010):

$$BCF = C_{Shell} / C_{water}$$

$$BCF = C_{Shell} / C_{Sediment}$$

RESULT

Physical-Chemical Parameter

The measurement results of the physical chemical parameters of the estuary waters are shown in Table 1.

Table 1. Physical and chemical parameters of the waters at the study site

Parameter	Unit	Value
Temperature	°C	36±0.58
Salinity	ppt	25±1.15
pH	-	7.21±0.06
Current	m/s	0.02±0.002

Size of *Polymesoda* sp

Polymesoda sp length data from 100 samples obtained length range of 23-77mm. This data is grouped into three size groups namely Small (23-41mm); medium (42-59mm) and large (59-77mm). The number of shells obtained in each group is shown in Table 2.

Table 2. The number of shells obtained in each group

Group	Length Range (mm)	Number
Small	23-41	37
Medium	42-59	41
Large	60-77	15

Metal in Seawater

Concentrations of heavy metals Pb, Cd, Cu and Cr in seawater at the *Polymesoda* sp shell sampling location can be seen in Figure 2.

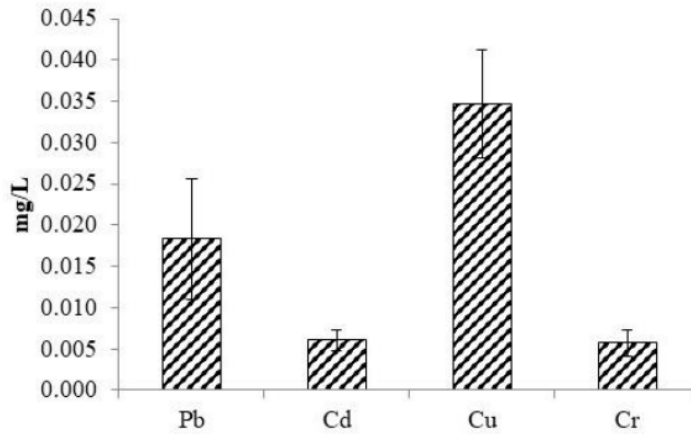


Figure 2. Pb, Cd, Cu and Cr metal concentrations in seawater at the side location

The highest concentration of heavy metals in seawater at the location of shellfish sampling is Cadmium type followed by Plumbum type, the lowest concentration of chrome type.

Metal in Sediment

The results of measurements of the concentration of heavy metals Pb, Cd, Cu and Cr in the sediment are shown in Figure 3.

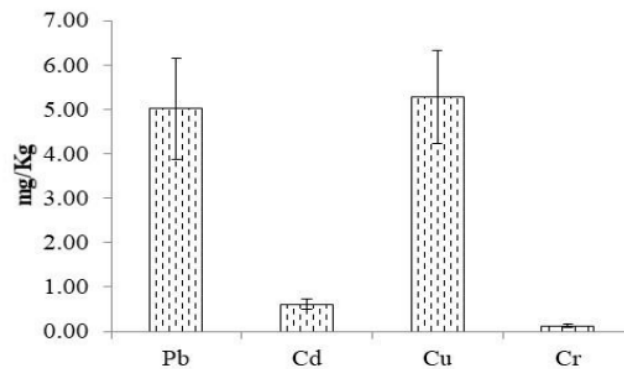
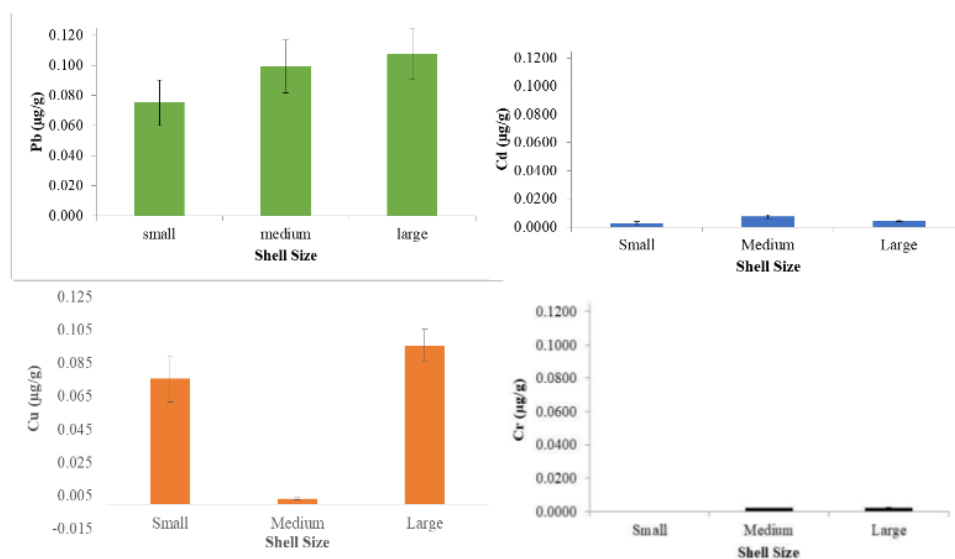


Figure 3. Pb, Cd, Cu and Cr metal concentrations in sediment at the side location

The concentration of heavy metals in the sediment is highest in the types of Cu and Pb, while the low concentrations are in the metals Cd and Cr

Metal in *Polymesoda* sp

3 The results of the analysis of the concentrations of heavy metals Pb, Cd, Cu and Cr on various sizes of small, medium and large *Polymesoda* sp shells are shown in Figures 4.



1 Figure 4. Heavy metal concentrations of Pb, Cd, Cu and Cr in various sizes of *Polymesoda* sp Bioconcentration Factor (BCF)

1 Table 3. Bioconcentration Factor Values of heavy metals from water and sediments

Group	Water				Sediment			
	Pb	Cd	Cu	Cr	Pb	Cd	Cu	Cr
Small	4.1	0.4	2.2	0.0	0.02	0.00	0.01	0.00
Medium	5.4	1.2	0.1	0.4	0.02	0.01	0.00	0.02
Large	5.9	0.7	2.8	0.4	0.02	0.01	0.02	0.02

The accumulation of metals from water shows that the larger size of *Polymesoda* sp shells accumulates more Pb and Cu metals than other metals. While the highest accumulation of Cd in medium size. Metal accumulation from sediments shows the same level of accumulation of *Polymesoda* sp shells in various size groups. Cr metal types are not accumulated by shells in small size groups.

DISCUSSION

The values of the temperature, salinity, pH and current velocity parameters are still suitable for the life of *Polymesoda* sp. (Table 1). The water temperature is at a relatively high value compared to natural waters which is an average of $36 \pm 0.58^\circ\text{C}$, but still at a value that supports the life of the shellfish. An average water salinity of 25 ± 1.15 ppt indicates brackish waters, *Polymesoda* sp shells commonly found in brackish waters (Mendoza *et al.* 2019). The pH value of the waters is still at a relatively alkaline value that is equal to 7.21 ± 0.06 , while the current speed is relatively low at 0.02 ± 0.002 m / s.

The results of measuring the length of the shell from 100 samples obtained size range of 23-77 mm (Table 2). The size of these shells is relatively large when compared to those obtained

in Philippine waters which range from 29.6 - 73.5 mm (Mendoza *et al.* 2019). However, this size has not yet reached the maximum size found which is 107.1 mm (Dolorosa *et al.* 2014). This measure is included in the size category that is widely consumed by coastal communities.

The value of heavy metal content in the waters of the sampling locations is relatively low and is below the Indonesian seawater quality standard for biota at 0.08 ppm. Of the four types of heavy metals, Cu is the type with the highest concentration then Pb (Figure 2). This shows that the waters receive heavy metals in quantities that are still low.

Heavy metal levels of Pb, Cd, Cu and Cr in sediment showed high levels of Cu and Pb (Figure 3). The content obtained is quite low when compared to the results of research from Jitar *et al.* (2015) found that the levels of heavy metals Pb, Cd, Cu and Cr on the Romanian coastline of the Black Sea were much greater, each at $8.42 \pm 5.52 \mu\text{g/g}$; $0.90 \pm 0.91 \mu\text{g/g}$; $17.76 \pm 15.86 \mu\text{g/g}$; $30.26 \pm 22.90 \mu\text{g/g}$. and Werorilangi *et al.* (2016) found heavy metals Pb and Cu in Spermonde waters sediments of 0.4-1.5 $\mu\text{g/g}$ and 3-8 $\mu\text{g/g}$.

Based on the size of *Polymesoda* sp. there are differences in the accumulation of heavy metals in which large-sized shells accumulate larger than those of small and medium size. But in general the concentration of heavy metals in shellfish is still low. This is in line with what is found in water and sediments. Concentration in *Polymesoda* sp. Shells ranged from 0 - 0.11 $\mu\text{g/g}$. Compared with those found by Ong and Ibrahim (2014) the concentration value in *Polymesoda expansa* was Cu, 15.5 $\mu\text{g/g}$; Pb, 2.31 $\mu\text{g/g}$ and Cd, 1.04 $\mu\text{g/g}$. Heavy metal content of *Polymesoda* sp from the waters of Parepare Bay is still very low. When compared with Indonesian food standards for Pb heavy metals of 1.0 $\mu\text{g/g}$; Cd of 1.5 $\mu\text{g/g}$ and International Standards of 2 $\mu\text{g/g}$; Cd of 6 $\mu\text{g/g}$ the concentration in shellfish is still very low and suitable for consumption.

BCF values indicate that the accumulation of heavy metals in *Polymesoda* sp shells comes from the water column. The BCF value of Pb metal water shows that *Polymesoda* sp shells in all size categories absorb Pb from the water column. While the BCF value of accumulated Cd metal water is only of medium size and the accumulated BCF value of Cu metal water is small and large. The BCF value of Cr metal water shows very low accumulation.

CONCLUSION

The accumulation of heavy metals Pb, Cd, Cu and Cr of *Polymesoda* sp shells in Parepare waters is still relatively low. The size of the shells influences the rate of accumulation, which is where the shells with large sizes accumulate more for the types of metals Pb and Cu than Cd and Cr metals. Based on national and international food standards, *Polymesoda* sp. Shells in the waters of Parepare Bay are still suitable for consumption by the community.

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