

Analysis of heavy metals content (Pb, Hg and Cd) of *Batissa violacea* Lamarck in the coastal waters of Calang

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Abstract. The objective of the study was to determine the content of heavy metals (Pb, Hg and Cd) of *Batissa violacea* Lamarck in the coastal waters of Calang. The research was conducted in Krueng Sabee and Panga on February 2014. Samples were collected from three stations. Samples were analyzed using AAS at Laboratory of BARISTAND. It was obtained that the heavy metals (Pb and Cd) content in *B. violacea* Lamarck at three stations were above the threshold value for food according to SNI No 7387 year 2009. For the mercury (Hg), it was still under the threshold at all stations. The lead (Pb), mercury (Hg) and cadmium (Cd) content at station 1 were 6,93; 0,71; 2,54 mg/kg, respectively. Further, at station 2, they were 5,33; 0,49; 2,33 mg/kg, respectively and at station 3, they were 5,07; 0,49; 1,8 mg/kg, respectively.

1. Introduction

Shellfish is a biota whose life is sessile or slightly moving and includes macrozoobenthos because the shells live on the bottom of the waters. Shellfish are filter feeder, which is by taking food through filtering suspended substances in the water, so that it will be easily affected by the presence of heavy metals around it. Heavy metal will enter the body of the shell, and will accumulate in the cells or tissues of the shell. If the shells that have accumulated heavy metals are consumed in large quantities it will be dangerous for humans.

Aceh Jaya district, especially Krueng Sabee River is suspected to have been contaminated with heavy metals, due to gold amalgamation activity around the area. According to the Serambi news on February 19th, 2014 about 62% of community wells were contaminated with mercury, including Krueng Sabee and Panga sub-district. The mercury contamination had also reported found in seafood consumed by the community, such as fish, shrimp, and shellfish (lokan) found in the river of Krueng Sabee sub-district and its surroundings (Source; exclusive interview on the Serambi on February 20th 2014).

Every day, several chunks of stone containing gold ores were distributed to the areas of gold mining process in Krueng Sabee sub-district, some of them were home industries [1]. Tailings from the gold amalgamation process allowed mercury waste to be scattered around the mining area to become the source of heavy metal pollution in these areas. If the waste was simply discharged into the Krueng Sabee watershed and flew to the coastal areas, it would also settle in river estuaries [2].

Heavy metals are metals that are dangerous and toxic to humans, animals and plants, and can pollute the environment. In the conventional gold mining, mercury is used in its amalgamation process. This can produce mercury waste dumped into the river. This dangerous metal will contaminate the water and the biotic animals in the waters.



2. Materials Methods

2.1 Sampling

Samples of *Batissa violacea* Lamarck with a width of 3 cm and a height of 2 cm were collected from Krueng Sabee and Panga sub-district, Calang waters on February 2014. Three stations were observed, included downstream of Krueng Sabee river as station 1, middle littoral of Panga coastal as station 2, and east littoral of Panga coastal as station 3. Samples were analyzed at BARISTAND laboratory, Banda Aceh. The observed sites are described in Figure 1.

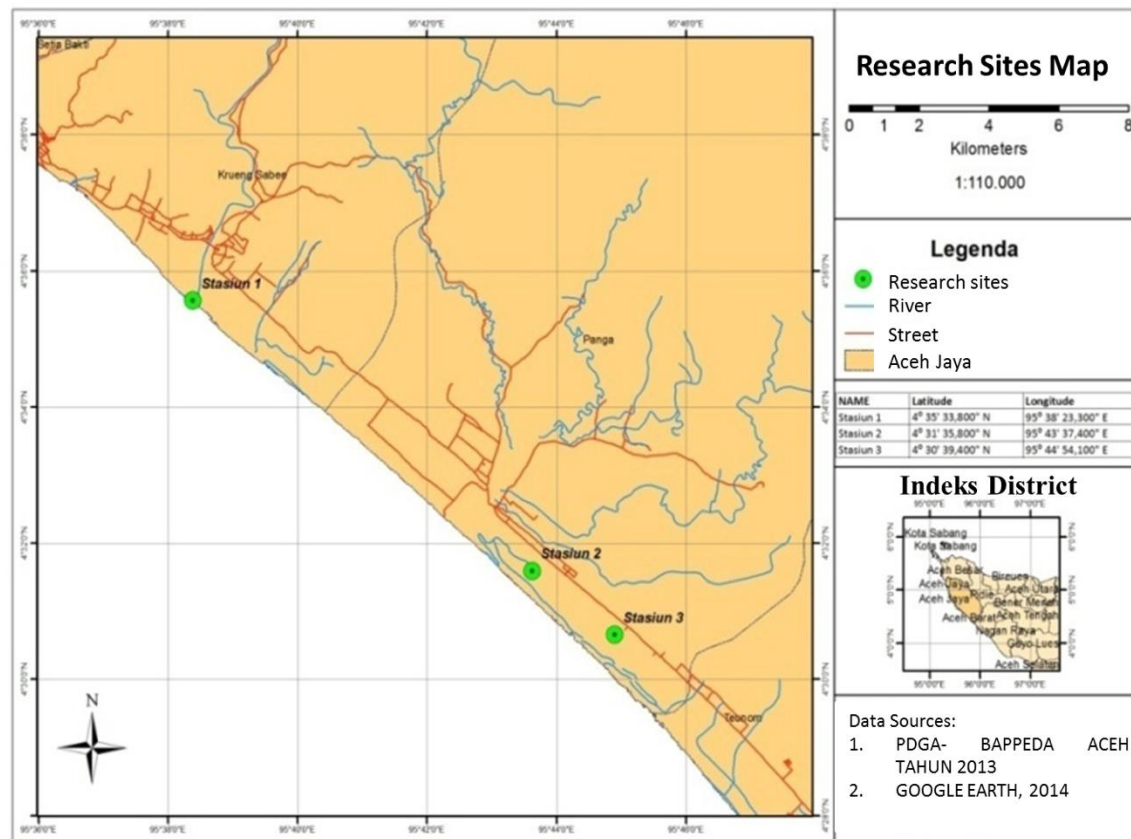


Figure 1. The observed sites were located in Krueng Sabee and Panga sub-district, Calang waters.

2.2 Sample treatment

The collected samples were put into plastic bags by adding water and oxygen, then labelled. Before being analyzed, shells were washed, then sliced using scissors, grinded and weighed as much as needed.

2.3 Process of destruction

2.3.1. Metal Pb and Cd. Five grams of mashed sample was put into a 100 ml beaker glass, then added 20 ml of HNO_3 and heated on a hot plate, the temperature was set at 155 °C. After 5 minutes, the temperature was raised to 180 °C until sample was dissolved, then the temperature was reduced to 140 °C to reduce the volume to 5 ml. The dissolved sample was diluted using distilled water in 50 ml volumetric flask to the boundary mark.

2.3.2. *Metal Hg.* Another 5 grams of mashed sample was put into a 200 ml beaker glass, then added 20 ml of HNO_3 , 10 ml of KMnO_4 , 5 ml of H_2SO_4 , and 5 ml of $\text{K}_2\text{S}_2\text{O}_4$. The mixture was diluted by adding the distilled water to 200 ml and heated on a hot plate with a temperature under 100°C .

2.4 Calibration curve

The standard calibration curve used to determine Pb, Hg and Cd metals content was obtained by using the absorption value of standard solutions of each element at the optimum wavelength of each element. Then the linearity of the calibration curve was made with standard solutions of Pb, Hg and Cd. Each standard solution with a concentration of 1000 ppm on a 10 ml pipette, put into a 100 ml volumetric flask, added 5N HNO₃, diluted with distilled water to the boundary mark, so that 100 ml of 100 ppm mother liquor was obtained. The 100 ppm solution is used as a stock solution to make standard solutions.

The standard solution of Pb were diluted into 5 concentrations, namely 0, 1, 2, 5, and 10 ppm. While standard solution for Hg were diluted into 4 concentrations: namely 0, 4, 8, and 20 ppm. Four concentrations of standard solution for Cd metal were marked by 0, 1, 2, and 5 ppm. They were measured at the optimum wavelength at 217.0, 253.7 and 228.8 nm for Pb, Hg and Cd, respectively.

2.5 Atomic Absorption Spectrophotometer (AAS) for Metal Analysis

Metals (Pb, Hg, and Cd) were analyzed by AAS. The AAS was turned on, the standard solution and the sample are filled into the test tube of AAS, and set in the AAS-connected computer. In case of Pb and Cd, turning on fire and cathode lamp were necessary. The position of the lamp was also set to obtain the maximum absorption. In case of Hg, it was used the cold steam method, as Hg is a volatile metal at high temperature. The standard solutions and analite were aspired respectively into the vapour of acetylene. The absorption result was noted and used to determine the metal concentration in the analite. This was calculated as regression concentration.

2.6 Data Analysis

The metal content in the solution was calculated using the formula as follows:

$$\text{metal content } \left(\frac{\text{mg}}{\text{kg}} \right) = \frac{C_{\text{reg}} \times P \times V}{G} \quad (1)$$

Where C_{reg} = Regression concentration (mg / L); P = dilution factor; V = dissolution volume (L); G = sample weight (kg).

3. Results and Discussion

The content of heavy metals Pb, Hg and Cd in *B. violacea* Lamarck is presented in Table 1. The levels of Pb and Cd metals in the sample are exceeded the threshold set by the Indonesian National Standard, but the metal Hg was still under the threshold.

Tabel 1. Heavy Metal Content in *B. violacea* L. from three stations of Krueng Sabee and Panga

No	Metal	Unit	Result / station			SNI (2009)
			1	2	3	
1	Lead (Pb)	mg/kg	6,93	5,33	5,07	1,5
2	Mercury (Hg)	mg/kg	0,71	0,49	0,49	1,0
3	Cadmium (Cd)	mg/kg	2,54	2,33	1,8	1,0

According to SNI-7387-2009 concerning the content of allowed heavy metals in bivalves, mollusks and sea cucumbers, Hg is allowed to 1 mg/kg, Pb is 1.5 mg/kg and Cd is 1 mg/kg. It was found that the Hg content in *B. violacea* L. collected from Krueng Sabee and Panga on February 2014 was still under the prescribed threshold, while the levels of Pb and Cd had exceeded the threshold set by SNI-7387-2009.

The high metals content of Pb, Hg and Cd at station 1 is due to the site located at the downstream of Krueng Sabee River. This area was known as a dumping place for gold mining waste from Gunong Ujeun, Krueng Sabee sub-district. Iwandikasyah [3] reported that the mercury content in the downstream of Krueng Sabee River was higher than in the upstream and median of the river. As the downstream,

this site became the storage of mercury accumulation. It was suspected that metal mercury settled on the river bed and was absorbed by *B. violacea*.

While the metals content at stations 2 and 3 found less than station 1. This due to the site out of the river, which is located in the littoral of the coastal, so this site is less contaminated by the waste. However, the location gets the influence of high tide, so that the content of heavy metal in this location is thought to originate from absorbed sediment containing heavy metals.

The mercury content in three locations on February 2014 was ranged from 0.49 to 0.71 mg/kg. This value was still under the SNI threshold. Previous research by Iwandikasyah [3] in the upstream, median and downstream of Krueng Sabee River showed that the mercury content in *B. violacea* L. was ranged from 0.349 to 2.364 mg/kg. Mukhlisiddin *et al.* [4] explained that the estimated use of mercury in the mining area reached 3 kg/day/unit, with the number of refineries operating approximately 100 units, it was estimated that the use of mercury was 300 kg/day. If the depletion of mercury was lost by water about 30%, so the amount of mercury entering the Krueng Sabee River would be 90 kg/day, this was equivalent to 32.4 tons/year.

Serambi Newspaper on July [6] reported that the Aceh Jaya District Government issued a warning letter to the illegal gold mining located in Gunong Ujeun should be closed without official permission from government agencies. The government also urged the miner not to dispose waste into the Krueng Sabee River. The Hg content in shellfish in 2009 was exceeded the threshold value [6], the highest value was at the downstream of Krueng Sabee, while in 2014 it was found below the threshold. This is due to the number of illegal gold mining was reduced and the biotic animals such shellfish were also changed.

Pb is known to come from burning residues in vehicles, Pb can pollute the air and also waters when it is in direct contact with this heavy metal. Waste from the industry related to Pb includes from lead ore mining, the rest of the battery used and burning fuels. These wastes will flow in the waterways causing pollution [5]. Pb contamination was assumed to have originated from other industrial effluents or due to water transport activities around the research area. Murphy [7] reported that if the waters contaminated with Pb metal with a concentration of 2.75 - 49 ppm, then aquatic biota such as crustaceans will die within 254 hours. Pb metal contamination found in the biota of *B. violacea* Lamarck was assumed to be related to the flow of sulphuric acid which dissolved Pb metal in certain channels contaminated by this metal. Apart from the Pb metal contamination that has passed the threshold, the Cd content has also exceeded the threshold set by SNI-7387-2009. Cd metal usually comes from industrial waste related to metal Cd. The Cd waste suspected from pesticide contamination due to agricultural activities of residents around the study area. The Cd contamination found in the sample was related to sulphide acid flow discharge. Sulphide acid dissolved in water is thought to have dissolved Cd in the stream and dumped it into the river.

4. Conclusion

Based on the research, it can be concluded that Pb and Cd content in *B. violacea* Lamarck in Aceh Jaya coastal waters on February 2014 had exceeded the maximum threshold of heavy metal contamination in food according to SNI 7387 in 2009, while the Hg content in *B. violacea* Lamarck was found still under the prescribed threshold.

Acknowledgment

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