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# Heavy metal contamination of Hg and Pb in water, sediment and Violet Batissa (*Batissa violacea* Lamark, 1818) meat in Teunom River, Aceh Jaya Regency, Indonesia

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ABSTRACT

Violet Batissa (*Batissa violacea*) is an important economic organism on the west-south coast of Aceh, because it is relatively high consumed by the community. However, gold mining activities carried out around the watershed are estimated to pollute the river and cause *B. violacea* to also be affected. The purpose of this study was to determine the level of mercury (Hg) and Lead (Pb) contamination in clam meat in Teunom, Aceh Jaya Regency. The research was conducted from June to September 2021. Sampling of clam was done by purposive sampling method. Hg and Pb were analyzed in clam meat using the Atomic Absorption Spectrophotometer (AAS) method. The results of the analysis showed that the Hg content in clam meat was between 0.12-0.63 mg/kg (mean 0.35±0.26 mg/kg), water 0.0026-0.0103 mg/kg (mean 0.0052±0.004 mg/kg), and sediment 1.3224-3.8767 mg/kg (mean 2.2324±1.427 mg/kg). Furthermore, the results of the analysis showed that the Pb content in clam meat, water and sediment had the same value at 3 stations with values <0.0002±0 mg/kg, <0.0003±0 mg/kg, and <0.0002±0 mg/kg, respectively. The conclusion of this study is that the Hg content in water and sediment has exceeded the threshold, while the clam meat is still in good quality standards. The Pb content in clam meat, water and sediment were also in good quality standards. Based on our study, *B. violacea* is still safe for consumption, while the water has been polluted and is recommended not to be utilized for human consumption.

## Introduction

Violet Batissa (*Batissa violacea*) is one of the important aquatic resources for human. The species can be found in various Aceh waters, including Aceh Jaya (Nurfadillah *et al.*, 2018; Suhud *et al.*, 2020). One of the broad distribution areas of *B. violacea* in Aceh Jaya is in Teunom District. Since decades ago, this district has been known for its clam production area, especially freshwater clams (*B. violacea*). Until now, the Banda Aceh – Meulaboh Aceh Barat route, precisely in the villages of Seunebok Padang, Batee Roo, and Aron - Tanoh Manyang dozens of traders selling clams of various sizes. The results of our survey on November 2, 2020 at the *B. violacea* sales center in Teunom District found that the average size of clams sold by traders were: large size with an average weight of 135.68 g, length 76.5 mm, 85.92 mm wide, and shell thickness 42.56 mm; medium size with an average weight of 52.38 g, length 59.79 mm, width 67.09 mm and shell thickness 35.0 mm; small size with an average weight of 10.98 g, length 35.7 mm, width 38.78 mm.

Since the community initiatives to collect clams still continue in Teunom District, the populatoin of *B. violacea* is thought to have declined in recent years. Population decline is also suspected that some of

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their habitats are contaminated with heavy metals sourced from gold mining in the upstream of Teunom River which borders the Geumpang District, Pidie Regency (Wahidah *et al.*, 2019). Another source of pollution is thought to come from agricultural waste and domestic waste adjacent to the waters as a location for catching/collecting clams. Pollution from agricultural waste can come from the use of several pesticides such as herbicides, fungicides and insecticides for pest control. Sukarjo *et al.* (2019) reported that pesticides contain As 0.8-60 ppm, Cu 4-56 ppm, Hg 0.6-42 ppm, Mn 1-17 ppm, Pb 11-60 ppm, and Zn 1-30 ppm. Furthermore, Maddusa *et al.* (2017) reported that there was an increase in Zn and Pb in the Tondano River, North Sulawesi, due to the activity of disposing of household waste and agricultural waste using fertilizers and pesticides.

Several studies on clams in Indonesia have been reported, including the distribution and diversity in the intertidal zone in Gresik Regency (Zarkasyi *et al.*, 2016), the Lapindo Mud disposal area (Insafitri, 2010), Waemulang beach (Samson et al., 2020), Seagrass ecosystem in the waters of Jepara (Riniatsih and Widianingsih, 2007). Meanwhile, several studies of clams that have been carried out in Aceh include diversity, habitat characteristics and community structure in the mangrove ecosystem of Kampung Jawa Banda Aceh (Ramadhaniaty et al., 2020), coastal areas of Aceh Jaya Regency (Hermi et al., 2021), and coastal areas Teluk Nibung, Pulau Banyak District, Aceh Singkil Regency (Syahputra et al., 2017). However, the safety of clams as food and its ecology (water and sediment) has never been carried out in the Teunom River so that it has a high urgency level. Accumulation of heavy metals mercury (Hg) and Lead (Pb) in aquatic biota, especially *B. violacea*, has a significant impact on the health of those who consume them (Wong *et al.*, 2002; Shoults-Wilson *et al.*, 2015), where *B. violacea* does not only consumed by the local community, but also people outside the District of Teunom.

## Materials and Methods

### Location and time of research

This research was conducted from June to September 2021. The research location is in the Teunom River, Teunom District, Aceh Jaya Regency (Figure 1). Analysis of the research sample was carried out at the Laboratory of the Research and Industrial Standardization Institute, Banda Aceh, Indonesia.

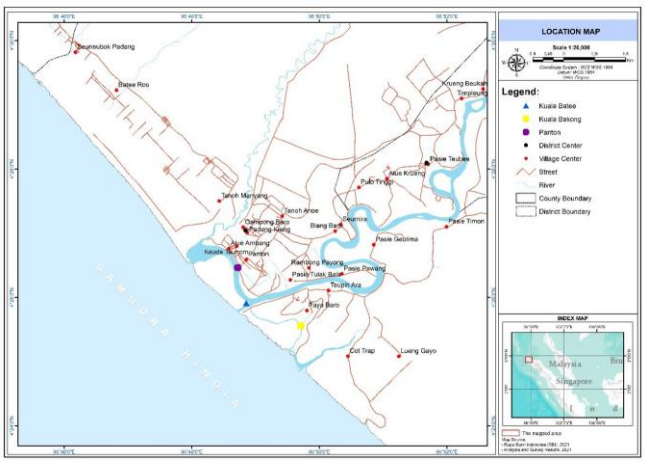


Figure 1. Research map marked red dot.

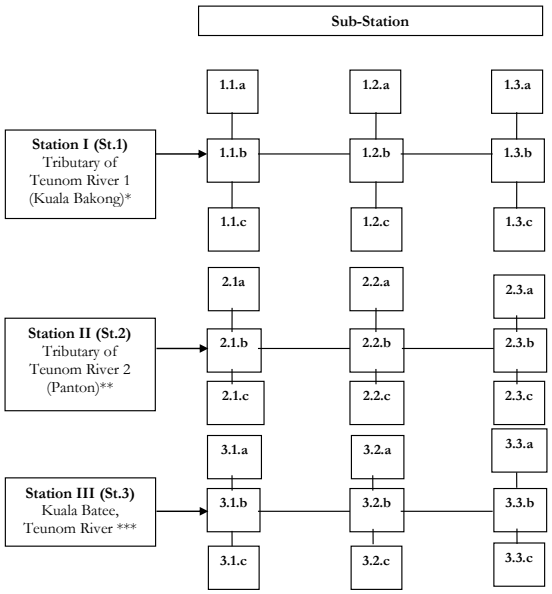


Figure 2. Sampling design at each observation sub station, where *A tributary bordering the rice fields; **A tributary bordering a residential area; *** Estuary of the main river (without residential housing).

### Research methods and design

Sampling of clam was done by purposive sampling (Suhud *et al.*, 2020). The observation station consists of three (Figure 2), each station consists of three observation substations. Sampling at each substation was carried out in the left, middle and right areas of the river (Zarkasy *et al.*, 2016).

### Sample preparation procedures and heavy metal analysis

Sampling of clam, sediment and water were carried out at each predetermined observation station. The clam samples were taken by feeling them in the mud using hands or a small shovel, sediment samples using the small shovel and water samples using a bucket. The collected clam samples were then cleaned and put into plastic bags that had been labeled according to each station, then the calm were

split and the meat was taken, while sediment and water samples were immediately put into plastic bags and labeled. The clam meat, sediment and water samples were then brought to the Laboratory of the Research and Industrial Standardization Institute, Banda Aceh, Indonesia to analyze the content of heavy metals Hg and Pb using the Atomic Absorption Spectrophotometer (AAS) method.

## Results

The results of the analysis showed the average value of heavy metal Hg in clam meat at St. 1 reached 0.63±0.49 mg/kg and has exceeded the tolerance threshold, followed by St. 3 and St. 2 with values of 0.3±0.17 mg/kg and 0.12±0.09 mg/kg, respectively. Heavy metal contamination of Hg in water samples, the highest average reached 0.0103±0.007 mg/kg at St. 3, followed by St. 2 (0.0028±0.002 mg/kg) and St. 1 (0.0026±0.002 mg/kg). Heavy metal contamination of Hg in sediment samples, the highest average reached 3.8767±1.041 mg/kg at St. 3, followed by St. 1 (1.4982±0.548 mg/kg) and St. 2 (1.3224±1.807 mg/kg). Based on the average value of heavy metal Hg in sediment samples at each St. revealed that it had exceeded the contamination threshold, while the water samples were only found in St. 3 (Table 1).

The results of the analysis of heavy metal Pb in samples of clam meat, water and sediment had the same average value with values <0.0002±0 mg/kg, <0.0003±0 mg/kg and <0.0002±0 mg/kg, respectively. This value indicates that the samples of meat, water and sediment are still within the contamination threshold (Table 1).

## Discussion

Based on the results of the analysis revealed that the Teunom River has been contaminated with heavy metals, where the Hg content has exceeded the threshold in the sediment samples at each sampling location. However, the Hg content exceeding the threshold in *B. violacea* meat was only found in St. 1 (Average value 0.63±0.49 mg/kg), while at two St. others are still within tolerance. Furthermore, Hg levels in water samples exceeding the threshold were also found in St. 3 (0.0103±0.007 mg/kg), while two St. others are still below the threshold. Pratush *et al.* (2018) and Yunus *et al.* (2020) revealed that toxic heavy metals that accumulate in sediments/water and change their natural composition will have a negative impact on living things and cause damage to vital organs of both animals and humans. In addition, the toxic effects of Hg will increase in breastfeeding infants of mothers who have been exposed and can cause mental retardation in adulthood (Schümann, 1990; Dufault *et al.*, 2009; Bose-O'Reilly *et al.*, 2010; Mohamed *et al.*, 2015).

Table 1. The average value of heavy metals Hg and Pb in samples of clam meat, water and sediment.

| Location | Sample | Mercury Hg (mg/kg) | | Lead Pb (mg/kg) | |
|---|---|---|---|---|---|
| | | Lab. Results | Standard | Lab. Results | Standard |
| St. 1 | Clam Meat | 0.63±0.49 | 0.5 | <0.0002±0 | 0.2 |
| St. 2 | | 0.12±0.09 | 0.5 | <0.0002±0 | 0.2 |
| St. 3 | | 0.3±0.17 | 0.5 | <0.0002±0 | 0.2 |
| **Average** | | **0.35±0.26** | **0.5** | **<0.0002**±0 | **0.2** |
| St. 1 | Water | 0.0026±0.002 | 0.005 | <0.0003±0 | 0.5 |
| St. 2 | | 0.0028±0.002 | 0.005 | <0.0003±0 | 0.5 |
| St. 3 | | 0.0103±0.007 | 0.005 | <0.0003±0 | 0.5 |
| **Average** | | **0.0052±0.004** | **0.0050** | **<0.0003**±0 | **0.5** |
| St. 1 | Sediment | 1.4982±0.548 | 0.15 | <0.0002±0 | 50 |
| St. 2 | | 1.3224±1.807 | 0.15 | <0.0002±0 | 50 |
| St. 3 | | 3.8767±1.041 | 0.15 | <0.0002±0 | 50 |
| **Average** | | **2.232444±1.427** | **0.15** | **<0.0002**±0 | **50** |

Description: St 1: Kuala Bakong; St 2: Panton; St 3: Kuala Batee.

Heavy metal levels of Pb were analyzed in samples of *B. violacea* meat, water and sediment at each St. research in the Teunom River shows that it is still in the tolerance level. The same results were also found in the Geumpang River which is upstream from the Teunom River, where the Pb content in water and sediment samples was still within tolerance levels (Nasir *et al.*, 2020). Furthermore, the lead (Pb) content in water and sediment samples in the Krueng Sabee River which is still in the same district with the Teunom River is also still within tolerance levels (Nasir *et al.*, 2021). However, another study revealed that the Pb content exceeded the threshold (up to 0.029 mg/kg) in other bivalvian species (*Crassostrea*

sp.) collected from the Lamnyong River, Banda Aceh, thus making it unsafe for consumption in the long term (Sarong *et al*., 2015).

Heavy metals Hg and Pb have a significant impact on human health when exposed to them for a long period of time. The main target of Hg heavy metal exposure toxicity in humans is the brain, although this type of heavy metal can damage any organ and cause impaired nerve, kidney, and muscle function (Baby *et al*., 2010; Kaur *et al*., 2019; Kim *et al*., 2019; Wang *et al*., 2020). Whereas Pb toxicity causes significant changes in various biological processes such as cell adhesion, intra-intercellular signaling, ionic transport, apoptosis, enzyme regulation, protein folding, and neurotransmitter release (Jaishankar *et al*., 2014; Ahamed *et al*., 2019; Ishaque *et al*., 2020). Therefore, concrete efforts need to be made in reducing the concentration of heavy metal contamination to the permissible threshold.

## Conclusion

Hg contamination in the Teunom River has been very worrying, especially in sediment samples in all research Station. The conclusion of this study is that the Hg content in water and sediment has exceeded the threshold can putting humans at risk, while the clam meat is still in good quality standards. The results of the analysis of the Pb content in clam meat, water and sediment were still in good quality standards, so efforts to keep its concentration low in the Teunom River must be carried out.

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