

ANALYSIS OF HEAVY METAL CADMIUM (CD) CONTENT IN THE IE SEU'UM HIT WATER AREA IN ACEH BESAR

Srie Wahyuni^{1*}, Ghazi Mauer Idroes², Natasya³

^{1,2,3}Department of Public Health, Faculty of Health Sciences Universitas Abulyatama,
Aceh Besar

E-mail: ¹⁾ sriewahyuni3139@gmail.com, ³⁾ natasya210601@gmail.com

Abstract

The Ie Seu'um hot springs area is located in Ie Seu'um Village, Mesjid Raya District, Aceh Besar Regency which has hot springs which are visited and used by the local community and tourists as a place for recreation with the family, a bathing place, and a place to boil food. Egg. The aim of this research is to determine and test heavy metals, namely Cadmium (Cd), which may be contained in the Ie Seu'um hot springs. The research used the AAS (Atomic Absorption Spectrophotometer) method. This research method uses a purposive sampling method, while the samples in this study were taken at spring points, namely places where people carry out egg-boiling activities and in holding tanks before the water flows into the bathing tubs. The results obtained for Cadmium (Cd) metal contained in hot springs (A) Ie Seu'um were <0.0005#) and reservoirs (B) were 0.0005#). Based on the maximum standard for Cadmium (Cd) content according to the Regulation of the Minister of Health of the Republic of Indonesia Number 2 of 2023 in the Clean Water Requirements for heavy metals, this heavy metal does not exceed the threshold and is below the detection limit of the test method. It is hoped that the results of this research can become basic information for the public and tourists to always protect the ecosystem of the Ie Seu'um hot spring area and preserve local wisdom.

Keywords: *Ie Seu'um Hot Water, Aceh Besar, Cadmium (Cd)*

1. INTRODUCTION

Heavy metals are toxic metals that are harmful when they enter the body beyond the threshold (Hananingtyas, 2017). It is a high risk for the environment and human health because it is toxic and easily accumulates in the food chain (Li et al., 2018). Cadmium (Cd) is one of the heavy metals with high toxicity and risk if present in the human body, especially in blood vessels. Cadmium is very influential on humans with a long period of time and can accumulate in the human body, especially in the kidneys and liver.

Examples of heavy metals that are harmful to organisms are arsenic (As), chromium (Cr), cadmium (Cd), mercury (Hg) and lead (Pb) (Pratiwi, 2020). Cd entering the waters can come from household, agricultural and industrial activities. There are two main sources of cadmium heavy metal contamination in the environment, namely through the earth layer, and human activities (anthropogenic) (Kartikasari, 2016).

There was a case of chronic cadmium (Cd) poisoning in the Tamoya region of Japan. Along the Jinzu River, female residents aged 40 and above contracted a disease called itai-itai. Where this disease causes softening of the bones caused by a lack of vitamin D caused by heavy metal cadmium (Cd), resulting in a disturbance in the balance of calcium and phosphate content in the kidneys, also known as *osteomalasea* or *itai-itai* disease (Kunsah, Kartikorini, & Ariana, 2021).

Heavy metal pollution in the waters of Jakarta Bay was first discovered by S. Yatim et al, the results of his research show that heavy metal levels in water in Jakarta Bay are already relatively high, even in some locations such as the Angke estuary heavy metal levels tend to increase. In research (Mardina, 2023) Gampong Terujak is a Gampong that has natural biodiversity in the form of hot springs. Generally, water sources are widely used by tourists as a place of recreation with family, can boil food (eggs) and a place to bathe or relax the body. Although the location of Terujak hot spring is still natural, the number of tourists and local community activities can affect the quality of Terujak hot spring.

The data obtained from the test results using the AAS method showed that the heavy metals Cd and Pb contained in the hot springs of Gampong Terujak amounted to 0.0972 ppm and 0.1587 ppm respectively. The maximum standard of Cd and Pb heavy metal content in clean water and drinking water requirements according to the Indonesian Minister of Health Number 416/Menkes/Per/IX/1990 is 0.005 mg/L and 0.05mg/L respectively; so it can be stated that the Cd and Pb content contained in Terujak hot springs exceeds the threshold of clean water and drinking water quality requirements.

Aceh Province has many geothermal areas which are the local potential of Aceh. One of the geothermal areas in Aceh is the Ie Seu'um geothermal area. Geothermal areas are areas that have a source of heat energy contained and formed in the earth's crust (Broto, et al., 2011).

Ie Seu'um is said to be a geothermal area as evidenced by the presence of hot springs which are manifestations of geothermal (geothermal). The Ie Seu'um hot spring area is located in Ie Seu'um Village, Mesjid Raya District, Aceh Besar Regency. Geographically, the Ie Suum hot spring is located around the mountains and is located about 17 Km to the north and is still a stretch of Seulawah Agam mountain, one of the active volcanic mountains in Aceh (Syukri, M., et.al. 2014).

Ie Seu'um spring is estimated to have a temperature of 89-92 °C with a geothermal reservoir temperature in the range of 186-204 °C, a medium enthalpy system, and a type of chloride fluid. The mineral content in the water is quite diverse, including bicarbonate, sulfate, chloride, sodium, potassium, and magnesium (Idroes., et al 2019). Ie Seu'um spring and its flow are located in a residential area so that the water is widely used by residents and tourists.

Ie Seu'um Village, Mesjid Raya District, Aceh Besar Regency is a village that has natural biodiversity in the form of hot springs. Generally, water sources are widely used by tourists as a place of recreation with family, can boil food (eggs) and a place to bathe or relax the body. Although the location of Ie Seu'um hot spring is still natural, the number of tourists and local community activities can affect the quality of Ie Seu'um hot spring. Therefore, this study aims to analyze the content of heavy metals Cadmium (Cd) in the Ie Seu'um hot spring area in Aceh Besar.

2. RESEARCH METHOD

The method used for sample collection in this study is purposive sampling method. The purposive sampling method is a method that reviews something by looking first

(research location survey). The equipment used is AAS (Atomic Absorption Spectrophotometer), jerry cans, cameras.

To obtain samples, surveys were conducted in the Ie Seu'um water area. Samples in this study were taken at two points, namely the spring where people boil eggs and the reservoir before the water flow into the bathtub.

2.1. Time And Place of Research

The sampling time was carried out on October 27, 2023. Then the samples were taken to the Laboratory of the Industrial Services Standardization and Policy Agency, Banda Aceh Industrial Services Standardization and Services Testing Laboratory on October 27, 2023. Hot water sampling was carried out in Ie Seu'um Village, Mesjid Raya District, Aceh Besar Regency. The research location can be seen in Figure 1.



Figure 1. Research location in Ie Seu'um Village, Aceh Besar

2.2. Sampling Stages

The stages or process of sampling before finally being taken to the laboratory. Before the hot water sample is put into the jerry can, to sterilize the jerry can by washing the jerry can with a hot water sample for 3 repetitions, then the hot water sample is put into the jerry can after it is allowed to stand for a few minutes after which it is closed to be taken to the laboratory.

3. RESULT AND DISCUSSION

3.1. Result

The results of Cadmium (Cd) metal content in the study are shown in Table 1.

Table 1. Heavy Metal Values of Ie Seu'um Spring Water Source and Reservoir Samples

No.	Test Parameters	Unit	Test Method	Requirements (Permenkes No.2 Year 2023)	Results	
					A	B
1	Cadmium (Cd) (dissolved)	Mg/L	SNI 3554:2015 grain 3.26.3.1	Max. 0,003	<0,0005 ^{#)}	<0,0005 ^{#)}

Description: #) : below the detection limit of the test method

The data obtained from the test results using the AAS method showed that the heavy metal Cd contained in the hot spring (A) Ie Seu'um was $<0.0005\#$) and the reservoir (B) was $0.0005\#$). The maximum standard of Cd heavy metal content in clean water requirements according to the Indonesian Minister of Health Number 2 of 2023 is 0.003 mg/L and 0.03mg/L so that it can be stated that the Cd content contained in spring water sources and spring water reservoirs does not exceed the threshold of clean water quality requirements and is below the detection limit of the test method.

3.2. Discussion

This research is not in line with Mardina (2023) which highlight that Gampong Terujak about the analysis of Cadmium (Cd) and Lead (Pb) content in the Terujak Hot Spring Ecosystem Area of East Aceh with the AAS Method, which obtained Cd results of 0.0972 ppm which exceeded the threshold of 0.005 mg/L .

This is because the East Aceh Terujak Hot Springs Ecosystem Area is believed to be due to the large number of tourists or the people of Gampong Terujak who come to the hot springs accessing the road to the hot springs with motorized vehicles and from plastic waste that may be found on the banks of the hot springs as a result of community activities that may burn garbage and boil eggs.

In Azhar et al's research, Cd metal is thought to come from plastic waste that may be found on the edge of hot springs as a result of activities. In this study the authors also found domestic waste around the spring water of Ie Suum Aceh Besar. However, the ecosystem area in Ie Seu'um Aceh Besar is fairly good due to the lack of activity of local residents and its distance from residential areas, which makes the Cadmium (Cd) content in Ie Seu'um Aceh Besar not exceed the threshold of Clean Water Quality Requirements and below the detection limit of the test method in accordance with the Clean Water Requirements according to the Regulation of the Indonesian Minister of Health Number 2 of 2023.

In this study using the latest maximum standard of Cd heavy metal content with Clean Water Requirements According to the Regulation of the Indonesian Minister of Health Number 2 of 2023 of 0.003 mg / L when referring to research (Mardina, 2023) Gampong Terujak on the analysis of Cadmium (Cd) and Lead (Pb) content in the Terujak Hot Spring Ecosystem Area, East Aceh using the maximum standard of Cd and Pb heavy metal content in clean water and drinking water requirements according to the Indonesian minister of health Number 416 / Menkes / Per /IX / 1990 of 0.005 mg / L and 0.05mg / L , so that in terms of regulations, it does not exceed the threshold.

Cadmium accumulates in the human body (half-life 15 - 33 years) and can damage the kidneys as the target organ in chronic exposure (Winata, 2016). The main human target organs of long-term cadmium exposure are the lungs, bones and the most severe are the kidneys, especially the proximal tubules, causing increased excretion of protein in the urine (Desfita, Sari, & Pato, 2020).

The danger of cadmium content when consumed can be acute or chronic. Acute poisoning causes symptoms such as respiratory tract disorders, nausea, vomiting, dizziness and back pain (Angelina, Darundiati, & Dangiran, 2017). While chronic effects can occur in the kidneys, lungs, bones, blood and reproductive system (Safitri, 2015).

Studies in humans and animals have shown that bone is a sensitive target of cadmium toxicity. Cadmium acts through direct and indirect mechanisms, which can lead to decreased bone mineral density and increased fractures. Studies in young animals show that cadmium inhibits osteoblastic activity, resulting in decreased bone organic matrix synthesis and mineralization.

Decreased osteoblastic activity may also affect osteoclastic activity leading to increased bone resorption. During intense bone growth, effects on osteoblasts result in decreased bone formation after bone maturity, cadmium exposure leads to increased bone resorption. Cadmium-induced kidney damage may also result in secondary effects on bone. Study results also prove that children are more susceptible to bone density loss and decreased bone strength due to cadmium exposure.

4. CONCLUSION

The maximum standard for Cadmium content in Clean Water Requirements according to the Indonesian Minister of Health Regulation Number 2 of 2023 is 0.003 mg/L. So, in terms of this regulation based on the results of research referring to these regulations, no cadmium (Cd) content was found in the Ie Seu'um Aceh Besar spring area because the results obtained were only $<0.0005 \mu\text{g/L}$ not exceeding the threshold of the quality standards of Clean Water Quality Requirements and below the detection limit of the test method. This value is categorized as safe, the community can use Ie Seu'um hot spring water for recreational activities because the Ie Seu'um spring area ecosystem is still maintained and far from residential areas.

REFERENCES

- Angelina, M. S., Darundiati, Y. H., & Dangiran, H. L. (2017). Analisis risiko kesehatan lingkungan kandungan kadmium (Cd) dalam ikan bandeng di kawasan tambak lorok Semarang. *Jurnal Kesehatan Masyarakat*, 5(5), 724-732.
- Broto, S. (2011). Aplikasi metode geomagnet dalam eksplorasi panasbumi. *Teknik*, 32(1), 79-87.
- Desfita, S., Sari, W., & Pato, U. (2020). *Susu Fermentasi Kedelai dan Madu Potensi untuk Meningkatkan Kesehatan Tulang Wanita Menopause*. Deepublish.
- Haningtyas, I. (2017). Studi Pencemaran Kandungan Logam Berat Timbal (Pb) dan Kadmium (Cd) pada Ikan Tongkol (*Euthynnus sp.*) di Pantai Utara Jawa. *BIOTROPIC The Journal of Tropical Biology*, 1(2), 41-50.
- Idroes, R., Yusuf, M., Saiful, S., Alatas, M., Subhan, S., Lala, A., Muslim, M., Suhendra, R., Idroes, GM, Marwan, M., et al. (2019). Eksplorasi Geokimia dan Penerapan Geotermometri di Zona Utara Seulawah Agam, Kabupaten Aceh Besar, Indonesia. *Energies*, 12, 4442.
- Kartikasari, M. (2016). *Analisis logam timbal (Pb) ada buah apel (Pylus Malus l.) dengan metode destruksi basah secara Spektrofotometri serapan atom* (Doctoral dissertation, Universitas Islam Negeri Maulana Malik Ibrahim).
- Kunyah, B., Kartikorini, N., & Ariana, D. (2021). Analisa Cemaran Logam Berat (Pb, Cd, Zn) Pada Makanan Dan Minuman Kemasan Kaleng Dengan Menggunakan Metode

- Spektrofotometri Serapan Atom (SSA). *The Journal of Muhammadiyah Medical Laboratory Technologist*, 4(1), 100-110.
- Mardina, V., Fitriani, F., Halimatussakdiah, H., Rahmadani, D., & Makhfirah, N. (2023). Analisis Kandungan Cadmium (Cd) dan Timbal (Pb) pada Kawasan Ekosistem Air Panas Terujak Aceh Timur dengan Metode AAS. *QUIMICA: Jurnal Kimia Sains dan Terapan*, 5(1), 1-4.
- Permenkes RI. (2023). Peraturan Menteri Kesehatan RI No. 2 Tahun 2023 tentang Peraturan Pelaksanaan Peraturan Pemerintah Nomor 66 Tahun 2014 Tentang Kesehatan Lingkungan.
- Pratiwi D.Y. (2020). Dampak pencemaran logam berat (timbal, tembaga, merkuri, kadmium, krom) terhadap organisme perairan dan kesehatan manusia. *Jurnal Akuatek*, 1(1), 59-65.
- Safitri, F. Z. (2015). Tingkat Efek Kesehatan Lingkungan Kandungan Logam Berat Kadmium (Cd) dalam Kerang Hijau (*Perna viridis*) yang Dikonsumsi Masyarakat Kaliadem Muara Angke Jakarta Utara Tahun 2015.
- Suprihatin, & Indrasti, N. S. (2011). Penyisihan Logam Berat Dari Limbah Cair Laboratorium Dengan Metode Presipitasi Dan Adsorpsi. *Makara Of Science Series*, 14(1).
- Syukri, M., Fadhli, Z., & Saad, R. (2014). The Investigation of Hot Spring Flow Using Resistivity Method at Geothermal Field Ie-Seu'um, Aceh-Indonesia. *EJGE*, 19, 2419-2427.

Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).