

Analysis of Heavy Metal Cadmium (Cd) Content in Snakehead Fish (*Channa striata*) from Lake Rawa Taliwang

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Abstract: Rawa Lake Taliwang is the lifeblood of the West Sumbawa Regency community. The lake is surrounded by extensive agricultural areas, making the activities of local farmers a significant contributor to the accumulation of heavy metals in the region. This study aims to determine the cadmium (Cd) content in snakehead fish (*Channa striata*) and assess its suitability for consumption. Sampling was conducted using *purposive sampling* with direct observation at Lake Rawa Taliwang. Nets or traps were employed at two stations, with two replications at each station. Data analysis involved calculating the cadmium content in the laboratory using Atomic Absorption Spectroscopy (AAS). The results revealed that the cadmium concentration in snakehead fish from Lake Rawa Taliwang was 0.45 mg/kg (ppm). This concentration exceeds the permissible limit for metal contamination in food, as stated in BPOM Regulation Number 9 of 2022. As a result, the snakehead fish is deemed unfit for consumption.

Keywords: Cadmium (Cd); *Channa striata*; Lake; Metal; Snakehead Fish

Introduction

Taliwang City is a city located in West Sumbawa Regency (Legiarsi et al., 2022). In Taliwang there is a lake that named with Swamp Lake Taliwang or Lake Lebo (Khairuddin & Yamin, 2021). Swamp Lake Taliwang is in the District Taliwang and District Seteluk, West Sumbawa Regency, West Nusa Tenggara Province. Swamp Lake Taliwang is at in management conservation under the Conversion Hall West Sumbawa Natural Resources (BKSDA) (Akbar, 2018).

This lake is muddy and quite in as well as depth mud different in each location. There are various type types plants that grow in this lake such us lotus white, tongue dragon, grass puzzle, turi swamp and water hyacinth goiter. Then, also plants kale growing on the edge lake and algae growing on the bottom lake. Lebo no only overgrown various type plant but there are also various types of fish that can be consumed by the community, including eel, betok fish, snakehead fish, catfish, head fish tin, tilapia fish, tilapia and sepat fish (Irianto et al., 2019).

This lake is pulse life public West Sumbawa Regency. The fish that live in the lake the is eye livelihood for public around. These fish arrested for consumed and sold (Wahyuni, 2019). Taliwang City own potency abundant gold cause many activities mining illegal gold especially in parts hills around Rawa Lake Taliwang. That matter Of course influential to level water pollution and organisms that live in lakes the because remains mercury and metals heavy others are used in processing help For obtain gold can carried by surface water and in to Swamp Lake Taliwang. Apart from that, Swamp Lake Taliwang is in an area surrounded by large rice fields, so activity nearby farmers can become contributor biggest accumulation metal heavy in the region (Khairuddin et al., 2018).

Metal heavy is one of material polluter waters whose existence is very dangerous although in amount small (Rosihan & Husaini, 2017). Metal heavy become pollutant dangerous Because no can degraded and therefore accumulate in the environment, potentially for pollute food (Paz-Ferreiro et al., 2014). One of metal the weight that

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can be pollute waters is cadmium (Cd). Cadmium (Cd) is metal heavy nature toxic and dangerous for creature life. Mining and industry are source from waste cadmium (Hayat et al., 2019; Oktavyandika, 2017; Wulan et al., 2023).

Cadmium (Cd) contained in the environment waters will enter to in bodies of aquatic biota and accumulate in a way Keep going continuously consequence exposure period long (Muslim et al., 2022). As for level maximum contamination metal heavy Cadmium is permitted in waters according to PP no. 28 of 2001 concerning Water quality is 0.01 mg/L (BPOM, 2022). Metal heavy cadmium can't destroy by organisms live in the environment and will accumulated to environment. Metal the weight inside waters though level relatively low, yes absorbed and accumulated in a way biological by aquatic animals and will involve in system chain food (Baby et al., 2010; Eko, 2020; Singh et al., 2022; Zhang & Reynolds, 2019).

This research is important to capture content metal heavy cadmiun (Cd) in snakehead fish found in Rawa Lake Taliwang West Sumbawa Regency. Then the people can keep the lake as the place that metal heavy cadmiun (Cd) in snakehead fish can lives. Fish are one of the most common aquatic biota used as bioindicators metal heavy in water. This matter because fish are classified level trophic supreme and nature naturally settle in certain habitats (Cahyani et al., 2016).

Fish cork is a carnivorous fish found in fresh water. Snakehead fish are also the fish that are most often found in waters lake lebo. This fish popular with the public Taliwang because it is rich in protein. Apart from that, snakehead fish are very good for consumed by new women giving birth and also discharged patient operation or post-operatively (Evrawaty et al., 2021). Fish cork as predator in chain food in freshwater waters can accumulate metal from the environment Then transfer it to man through the consumption process that can be cause disease acute and chronic (Oktavyandika, 2017). Based on description above and the amount possibility happen pollution by metal heavy on Swamp Lake Taliwang, then writer do study with objective to know content metal heavy cadmiun (Cd) in snakehead fish found in Rawa Lake Taliwang West Sumbawa Regency.

Method

Time and place study

The study was conduct at Rawa Lake Taliwang, West Sumbawa Regency. The location study on consideration topography that is station 1 (8°42'35.0"

LS, 116°051'21.0" BT) on the east and station 2 (8°42'17" S and 116° 51'26" E) on the west side.

After sample obtained sample is saved in a cool box, then destroyed in the laboratory FMIPA Unram Analytics Then analyzed at the NTB Environment and Forestry Service laboratory. Study This taking place in May – September 2023.

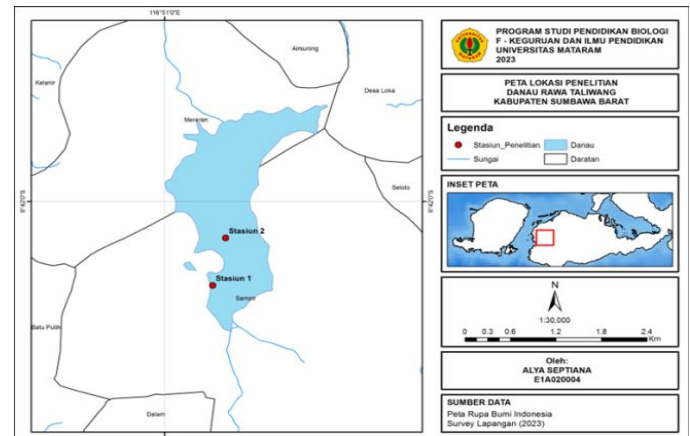


Figure 1. Map of research locations

Tools and materials study

Tools used in study This is equipment field and equipment laboratory. Field tools including pH meters, salinometers, conductivity meters, Secchi dise, *Global Positioning System* (GPS), camera, fishing net, cool box, and tools write. As for tools laboratory includes refrigerator, knife, balance analytical, term, volumetric pipette, flask, spoon plastic, dropper pipette, paper filter, petri dish and set tool *Atomic Absorption Spectrophotometry* (AAS). Whereas materials used _ includes snakehead fish as many as 2 tails from station 1 and station 2, distilled water, H₂SO₄, HCl 6 M, HNO₃ 0.1 M and HNO₃.

Data processing

Taking snakehead fish samples use method *purposive sampling* with observation in a way directly on Rawa Lake Taliwang. Snakehead fish found at the location (station) were caught with use fishing nets and traps (tools catch traditional).

Snakehead Fish taken as many as 2 heads. Samples that have been obtained Then saved in the cool box that has been filled with a little water then tied as well as left A little open to air can enter. Next sample brought from Taliwang City Going to Mataram for 5 hours of travel, then continued to Laboratory Analytic Faculty of Mathematics and Natural Sciences, Mataram University For destruction and the Environmental and Forestry Service Laboratory NTB Province for analyzed use AAS method. Of snakehead fish totaling 4 fish cleaned from scales and washed

clean. Snakehead fish that have been cleaned Then separated between bones and flesh. Fish meat is cut become pieces small. Pieces small snakehead fish meat weighed around 5 grams in Cup porcelain, then noted weight.

Then the destruction process is carried out with method snakehead fish meat entered to in pumpkin kjedhal different. Then added catalyst as much as 1 gram (mixture of $\text{Na}_2\text{SO}_4 + \text{CuSO}_4$). Then, add sour sulfate as much as 8 ml. Add 5 ml HNO_3 concentrated to in solution sample. Sample later heated with temperature 350°C using Kjeldhal term for 2.3 hours with heating 600 volts. After ash shaped perfect colored white, cool sample at temperature room . Add 5 ml of 6 M HCl to in each sample , shake it in a way Be careful until all ash dissolved with sour.

Furthermore, reading curve calibration and samples on AAS ie solution standard CD work is prepared at a minimum of 5 points concentration and as well solution standard work and samples read on the tool spectrometry Grahite furnace atomic absorption at length wave 253.7.

According to Rahmawati et al. (2015) *Atomic Absorption Device Settings Spectrophotometry* (AAS) includes: length wave 253.7 nm, speed acetylene at 2.0 L/ min , rate gap at 0.5 nm, rate flow air at 10.0 L/ min , and strong current 10 mA. Analysis with AAS, carried out with operate and optimize tool in accordance with instruction use tool for cadmium measurements, ie injected solution blank to in AAS later arrange absorption until zero, next injected solution standard one by one to in AAS, and measured the absorption is long wave 228.8 nm ago note the result.

Data analysis

Analysis data content Cadmium in the laboratory use AAS tool stated in unit mg/kg or in parts per million (ppm). The data obtained is processed in a way descriptive and presented in form tables and graphs. As for the formula For determine metal heavy cadmium as follow Formula 1.

$$\text{Konsetrasi Cd} = \frac{(D-E) \times Fp \times V}{W} \tag{1}$$

Information:

D = Concentration sample (mg/l) from results AAS reading (mg/l)

E = Concentration blank (mg/l) of results AAS reading (mg/l)

Fp = Dilution factor

V = Final volume solution sample (l)

W = Sample weight (Kg)

(National Standardization Agency, 2019)

Rate data cadmium obtained _ compared to with Food and Drug Monitoring Agency (BPOM) regulation

Number 9 of 2022 concerning condition pollution metal heavy in processed food form product processed fish is 0.30 mg/kg except for products processed fish included in cephalod or Shell of 1.0 mg/kg. If level cadmium in fish already exceed specified safe limit requirements so can impact negative to health people who consume snakehead fish.

Result and Discussion

Content cadmium in snakehead fish in Rawa Lake Taliwang

Data analysis of content test results cadmium in parts meat sample carried out at the Environmental and Forestry Service Laboratory NTB Province. Sample weight used at the station One namely 0.5109 grams and station two 0.5402 grams. Data analysis results and quality parameters environment presented in Tables 1 & 2

Table 1. Concentration Cadmium in Snakehead Fish

Sample location	Test	Concentration sample (mg/l)	Content Cadmium mg /kg (ppm)
Station 1	1	0.0023	0.45
	2	0.0023	0.45
Station 2	1	0.0020	0.43
	2	0.0020	0.43

Table 2. Quality Parameter Measurement Results Environment

Sample location	Temperature (°C)	pH	Salinity (ppt)
Station 1	29	7.0	0.5
Station 2	28.6	7.1	1

Pollution metal cadmium in Swamp Lake Taliwang originate from activity agriculture, mining and waste House ladder. Waste from activity the enter into the waters carried by water flows and empties into lakes. The rice field area is located No Far from Swamp Lake Taliwang, so water comes in the pass land existing rice fields polluted cadmium from fertilizers, herbicides and fungicides. This matter in line with Kirana et al. (2022) stating that habit farmer use fertilizer for various plant agriculture, use fungicides, insecticides, herbicides and types other poisons can give contribution to exists metal heavy is at Rawa Lake Taliwang (Ngatimin & Syatrawati, 2019).

Saber et al. (2021) also said that enhancement pesticides and fertilizers organic in a way excessive and continuous in period can take a long time cause contamination cadmium in soil agriculture and aquaculture the more increase. Apart from activities agriculture, lots of it activity mining gold around Swamp Lake Taliwang is also influential to water pollution and organisms that live in lakes that, because

remains mercury as well as metal heavy others are used in processing rocks For get gold can carried by surface water and in to in lake.

Metal heavily contaminated in Rawa Lake waters Taliwang furthermore accumulated by algae in the water and bottom waters, following chain food so that enter in fish body and accumulate. Kurniawan et al. (2019) stated that the water brings metal enter to aquatic plants that are eaten by small fish. Small fish that have eat plant accumulated metal Then eaten by big fish. Activity eat This causes big fish own content accumulation metal more weight Lots Because consuming small fish.

The results of the analysis of cadmium content are in line with previous research conducted by Septiani et al. (2022) concluding that the content of the heavy metal cadmium (Cd) in rice field snails (*Pila ampullaceal*) in Batu Kuta Village, Narmada District ranges from 0.361 – 0.554 ppm. Saputri et al. (2023) concluded that the cadmium level in tilapia fish meat was 0.1977 ppm. Saputri et al. (2023) concluded that the content of the heavy metal cadmium accumulated in the flesh of Merap snapper (*Lutjanus* sp.) was 0.0598 mg/kg. Other research also conducted by Khairuddin et al. (2022), found that the cadmium content in betok fish from Rawa Taliwang Lake was 0.011 ppm to 0.015 ppm.

Apart from that, research conducted by Muslim et al. (2022) regarding the cadmium content in milkfish in Bima Bay, the results showed that the cadmium content in milkfish had exceeded the set threshold, namely ranging from 10 to 40 ppm. Based on the results of this research, it shows that fish tissue can accumulate heavy metals. This is due to the indestructible nature of heavy metals, making them pollutants. Concentration metal heavy on Swamp Lake Taliwang can influenced by factors environment (Sany et al., 2023). Sun et al. (2023) said that mark concentration metal heavy changed caused exists change current, temperature, salinity, pH, ionic strength, amount and type material pollutants, as well depth. The data for measuring environmental parameters is carried out moment study that is measurement temperature, pH and salinity.

Measurement results temperature at the location research that is on the side east is 29°C while on the west side it is 28.6°C. Content metal heavy cadmium on the west side is lower compared on the side east. This matter in line with Al Husainy et al. (2014) stated that increasing temperature compare straight with increasing toxicity metal heavy in water. Khairuddin et al. (2022) also stated that increasing temperature will result accumulation metal heavy more increase in fish body.

pH measurement results obtained at the location research that is on the side east is 7.0 and on the west

side it is 7.1. This matter show that pH value at the location study side east more tall compared to with pH value on the west side. According to Rachmaningrum et al. (2015), increasing pH will lower solubility metal in water, because change stability from form carbonate become hydroxide will form mud.

The pH will decrease cause solubility metal heavy more high that will be cause toxicity metal heavy the more big. That matter in accordance with results research shows that concentration cadmium in fish taken on the west side is more low compared to with fish taken from side east of Swamp Lake Taliwang. However size temperature and pH obtained the Still is at within normal limits of water temperature and pH for snakehead fish. This matter in line with Dewi (2018) stating that snakehead fish generally lives in waters with a pH of 6.2 – 7.8 and a temperature of 26.5°C – 31.5°C.

In addition to temperature and pH, values salinity in waters can also be influential to toxicity metal heavy. That matter stated by Jia et al. (2021); Khan et al. (2020); Moiseenko & Gashkina (2020) that salinity influential to content cadmium in waters. Enhancement salinity will cause increasing formation of chloride ions. As for the results measurement salinity obtained at the location study side east is 0.5 ppt and on the west side it is 1 ppt. This matter in accordance with results research shows that concentration cadmium in fish taken on the side east tallest compared to the fish taken from west side of Swamp Lake Taliwang.

Appropriateness consumption of snakehead fish in Rawa Lake Taliwang

Food and Drug Monitoring Agency (BPOM) Regulation Number 9 of 2022 concerning condition pollution metal heavy cadmium in processed food form product processed fish is 0.30 mg/kg except for products processed fish included in *cephalod* or shell of 1.0 mg/kg. Based on matter the done calculation of average content Cadmium in snakehead fish samples is presented in Table 3.

Table 3. Average Content Cadmium in Snakehead Fish

Sample location	Test	Content cadmium mg/kg (ppm)	Average mg/kg (ppm)
Station 1	1	0.45	0.45
	2	0.45	
Station 2	1	0.42	0.43
	2	0.42	
Average Total mg/kg (ppm)			0.44

Source: NTB DLHK Laboratory (2023)

Table 3 shows that the snakehead fish found at station 1 and 2 exceeded the maximum limit content cadmium so that no safe for consumed. Accumulated

cadmium in body though in amount small can dangerous for health. Body man No own functioning mechanism for obstruct absorption cadmium, if exposed so will with easy absorbed by the body (Rosihan & Husaini, 2017; Wardhani et al., 2016).

Cadmium will undergo biotransformation and bioaccumulation processes in organism life like plants, animals and humans. In the body of aquatic biota amount accumulated metal will Keep going experience improvement and depth chain the highest biota food will experience accumulation cadmium more many. Cadmium will accumulate in body human and can go out from in body, however with range time 20-30 years forever. The resulting effect in bodies are also diverse like hypertension until cancer. In the body, cadmium will transport to heart by blood. Then form bond with protein, next transported to kidneys and accumulates. If contaminated will bother function kidney and damage ginjal. As for impact other that is diarrhea, vomiting, cracking bones, failure reproductive even infertility or sterility, damage system nerves center, damage system immunity, disorders psychological until DNA damage and cancer.

Cadmium became popular as metal dangerous weight after emergence pollution river in the Kumanto region Japan is the cause poisoning in humans (Hoshino, 2018; Teraoka et al., 2007; Walker, 2011). Pollution Cadmium in drinking water in Japan cause "itai-itai" disease. Symptoms caused that is abnormality bones and some body organs become dead. Poisoning chronic disease caused by cadmium is damage system physiological body for example breathing, circulation blood, smell, and can damage gland reproductive, kidney, heart as well as fragility bones (Agustina, 2014).

Cadmium in body can accumulates in the liver and is bound as metallothionein contain element cysteine, where cadmium bound to the cluster sulfhydryl (-SH) in enzyme like carboxyl cysteinyl, histidyl, hydroxyl, and phosphatidyl from purine proteins. Influence toxicity cadmium caused Because interaction cadmium with these proteins, so result exists disturbance activity Work enzyme in body (Paz-Ferreiro et al., 2014).

Conclusion

Based on research that has been done obtained conclusion that concentration cadmium in snakehead fish from Swamp Lake Taliwang is 0.44 mg/kg (ppm). Concentration cadmium in snakehead fish the exceed contamination threshold metal in food in accordance with BPOM regulation Number 9 of 2022, so snakehead fish the No worthy for consumed.

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Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this article.

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