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Cadmium (Cd) Levels In The Blood Of Communities Consuming Mystus Gulilo Around The Kenjeran Beach Area Of Surabaya With Atomic Absorption Spectrophotometry Method

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ABSTRACT

Cadmium is heavy metal with a toxic effect in the body, which is found in the environment of soil, air and water. Mystus Gulilo is one type of fish that can survive in polluted water such as Kenjeran Beach Surabaya, which is contaminated the heavy metal, cadmium. Mystus Gulilo that is consumed by humans accumulates in blood, settles for 75-128 days, and binds low molecular weight proteins that causing health problems, nerve damage, kidney damage, and red blood cell damage. This research is a descriptive study. The population in this research is the people who consume fish. The research specimens is blood, which taken by *purposive sampling*, requires people who consume Mystus Gulilo regularly for the last 1-3 months and aged 25-60 years. The research was carried out at the Surabaya Health Laboratory Center by using Atomic Absorption Spectrophotometry (AAS) apparatus. The results showed 3 respondents had a cadmium level exceeding the normal value with an average of 0.186 µg/dL, The age factor and the level of consumption affect the value of cadmium levels. The higher a person's age and the consumption levels of Mystus Gulilo they have, the higher the value of cadmium levels in their body and can cause chronic poisoning because the poison contained in the metal is carried to the body and accumulates over a long period of time, having an impact on the body's health, causing organ damage to death.
Keywords: Cadmium, Mystus Gulilo, Atomic Absorption Spectrophotometry (AAS)

INTRODUCTION

Kenjeran Beach Surabaya is a location of waters and fishing that direct and indirectly polluted by heavy metals including lead (Pb), arsenic (Ar), mercury (Hg), cooper (Cu), chromium (Cr) and cadmium (Cd) (1). Based on research (2), the overall average stated content of cadmium in Kenjeran Coastal water Surabaya is 0.0076 ppm. Fishes that obtained from polluted water, that in any way the bioaccumulation of the fish body contains heavy metal that exceeds the limit set by Food and Drug Supervisory Agency Regulation number 23 of 2017, will be dangerous if consumed continuously as it can endanger human's health (3).

Mystus Gulilo is one of the freshwater fish can survive in polluted water without dying. At the current time being, Mystus Gulilo still can be found around the Kenjeran Beach Surabaya and they will soon endanger the local communities' health if the fish are still consumed by them (4). (5) stated in his study that Mystus Gulilo's meat contains levels of cadmium with a range of 0.01 to 0.0057 ppm. Meanwhile, the Regulation of the Food and Drug Supervisory Agency number 23 of 2017 states that the maximum limit of cadmium (Cd) heavy metals contamination in fish food or fishery products is 0.10 mg/kg.

Heavy metals can enter the body of marine biota and accumulate from the food chain processes contained in the water. The more complex the level of a food chain, the higher the accumulation of heavy metals in the body. Bioaccumulation in fish causes humans to experience a process of bioaccumulation of heavy metals that enter the body and through absorption in the blood. Cadmium (Cd) that enters the body's bioaccumulation can potentially

become toxic, which can provide potential hazards in the human tissues, including poisoning, nerve damage, hypertension, red blood cell damage and kidney damage to death [6].
The habit of consuming fish obtained from polluted waters by wastewater allows the presence of heavy metal cadmium (Cd) in the human body. This can have a toxic effect and have an impact on the health of the human body. By this, a research is needed to analyze exposure to cadmium in the blood of people who consume Mystus Gulilo, specifically around Kenjeran Beach, Surabaya. This research is supported by using the AAS (Atomic Absorption Spectrometry) methods.

METHODS

This type of research is an analytical descriptive study with the aim of analysing the levels of cadmium (Cd) in the blood of people who consume Mystus Gulilo around the Kenjeran Beach Area of Surabaya that makes them also the population in this study. The research is the community taken by purposive sampling with the criteria of people who consume Mystus Gulilo regularly for the last 1-3 months and are 25-60 years old. The number of samples are 22. The sample size is obtained from questionnaires that have been distributed to the public and have signed a consent form to be used as research's respondent. The variable of this study is the level of cadmium (Cd) in the blood of people who consumed Mystus Gulilo around the Kenjeran Beach Area of Surabaya. This study uses primary data, which is obtained directly after conducting research in the laboratory. Data collections are done by taking the test material to its examination. This research protocol is ethically complaint with certificate number No. EA/412/KEPK-Poltekkes_Sby/V/2021. It is declared ethically complaint in accordance with 7 WHO 2011 standard.

Materials

This research requires an EDTA Vacutainer tube, tourniquet, alcohol swab, sterile cotton, syringe, plaster, safety box, and handscoon.

Preparation of 1000 ppm cadmium metal mother liquor cadmium

Prepare the main solution which contain cadmium chloride monohydrate $C_2Cl_2H_2O$ by performing the following calculations:

Molecular Weight $C_2Cl_2H_2O$: 201,32 g/mol
Molecular Weight Cd : 112,4 g/mol

$$M = \frac{Moleculular\ Weight\ (CdCl_2H_2O)\ g/mol}{BMolecular\ Weight\ Cd\ g/mol}\ x\ 1000\ g/mol$$
$$M = \frac{201{,}32\ g/mol}{112{,}4\ g/mol}\ x\ 1000\ mg/L$$
$$M(g) = 1{,}7911\ gram$$

Add 1.7911 grams of $C_2Cl_2H_2O$ to flask, 4 ml HNO3 of concentrated to dissolve, distilled water up to the mark, and then homogenize [8].

Preparation of 100 ppm standard solution

Prepare 10 ml pipette from 1000 ppm main solution, then put it into a 100 ml volumetric flask, and add distilled water up to the mark, then homogenize [8].

Preparation of 100 ppm standard solution

Prepare 10 ml pipette from a standard solution 100 ppm, then put it into a 100 ml volumetric flask, and add distilled water up to the mark, then homogenize [8].

Preparation of standard solution 1 ppm ; 2 ppm ; 3 ppm ; 4 ppm ; 5 ppm ; 6 ppm ; 7 ppm dan 8 ppm

Prepare 0,1 mL, 0.2 mL, 0.3 mL, 0.4 mL, 0.5mL, 0.6 mL, 0,7 mL and 0,8 mL pipettes of the 10 ppm standard solution and then put into a 100 mL volumetric flask with distilled water add up to the mark, then homogenize. Then obtain a standard solution of 1 ppm ; 2 ppm ; 3 ppm ; 4 ppm ; 5 ppm ; 6 ppm ; 7 ppm and 8 ppm [8].

Making Blanks
The blanks solution that is used in this examination of cadmium metal is distilled water [7].

Sample Preparation Wet Destruction
Prepare blood sample contained in a vacutainer tube, then homogenize blood sample by shaking the tube, after it mixed well, prepare pipette 1 mL of blood and insert it into the tube Nesler 50 mL, add 10 mL of concentrated nitric acid, then put it in the microwave that the temperature has been set below 150°C for about 20 minutes. After the solution is clear, add heavy metal-free aquadest to the 50 mL mark, then read in AAS [9]

Measurement of Standard Solution in AAS
Determination of the maximum wavelength can be done by installing a cadmium hollow cathode first, then turning of the AAS power button, and setting the AAS lamp to match the metal to be analysed via software. Set the wavelength to 228.8 nm. The wavelength obtained on the standard curve is used to determine a concentration of cadmium metal that are contained in the sample.

Sample Examination in AAS
Select the cathode lamp according to the analysis, then set the parameters to be analysed. Enter the blank first with a standard of 1 ppm; 2 ppm; 3 ppm; 4 ppm; 5 ppm; 6 ppm; 7 ppm; and 8 ppm. Insert the sample until the curve rises, and perform a sample check on the next sample by reinserting the blank. Then the instrument will read and record the absorbance [7].

Analysis Technique
Data obtained were analysed descriptively, quantitatively in the form of table and analysed by describing a situation that are occurred and connected the age factor, consumption level, and drawing conclusions. The data obtained were calculated as a whole by using the average and percentage to determine the number of samples exposed to cadmium in blood.

RESULTS

The examination of cadmium levels in the blood of people who consume Mystus Gulilo around The Kenjeran Beach Area of Surabaya that was conducted in this research at the Surabaya Health Laboratory Center, was done with the total of 11 respondents. The examination was carried out in duplicated number of samples, to wit 22 samples. The sample used in this study was 3 cc of EDTA blood. The data is presented in tabular form with the respondent's cadmium level checked in duplicate, so that the average value of the respondent's blood cadmium level is µg/dL.

Table 1 Examination Cadmium Levels in the Community Blood

No	Material Code	Age	Consumption Levels	Cadmium Value (Cd)	Mean
1.	BHN 1A	52 Years	3 times a month	0,087 µg/dL	0,089 µg/dL
2.	BHN 1B			0,092 µg/dL	
3.	BHN 2A	42 Years	≥ 3 times a month	0,164 µg/dL	0,168 µg/dL
4.	BHN 2B			0,173 µg/dL	
5.	BHN 3A	31 Years	3 times a month	0,094 µg/dL	0,090 µg/dL
6.	BHN 3B			0.087 µg/dL	
7.	BHN 4A	25 Years	3 times a month	0,068 µg/dL	0,071 µg/dL

8.	BHN 4B			0,074 µg/dL	
9.	BHN 5A	42 Years	≥ 3 times a month	0,207 µg/dL	0,232 µg/dL
10.	BHN 5B			0,257 µg/dL	
11.	BHN 6A	44 Years	3 times a month	0,059 µg/dL	0,055 µg/dL
12.	BHN 6B			0,052 µg/dL	
13.	BHN 7A	53 Years	3 times a month	0,047 µg/L	0,051 µg/dL
14.	BHN 7B			0,056 µg/dL	
15.	BHN 8A	40 Years	3 times a month	0,035 µg/dL	0,029 µg/dL
16.	BHN 8B			0,024 µg/dL	
17.	BHN 9A	60 Years	3 times a month	0,196 µg/dL	0,160 µg/dL
18.	BHN 9B			0,125 µg/dL	
19.	BHN 10A	46 Years	3 times a month	0,074 µg/dL	0,091 µg/dL
20.	BHN 10B			0,108 µg/dL	
21.	BHN 11A	41 Years	≥ 3 times a month	0,109 µg/dL	0,106 µg/dL
22.	BHN 11B			0,104 µg/dL	
			Average		0,103 µg/dL

Table 1 shows that the average value of cadmium levels in the blood of people who consume Mystus Gulilo as a whole is 0.103 µg/dL. In a small number of respondent, the value of cadmium levels exceeds the normal value, it is more than or equal to 0,12 µg/dL. In this result, the h value of cadmium levels was 0,232 µg/dL with consumption rate of more than or equal to 3 times a month and value of cadmium levels was 0,029 µg/dL with consumption level 3 times a month.

DISCUSSION

In this study, people's age affects the value of cadmium levels contained in people's blood. It can be seen in table 1 that respondents aged 60 years have an average value of 0.160 g/dL cadmium levels which are higher than those aged 25 years who have an average value of 0.071 g/dL cadmium levels with the same level of consumption, which is 3 times during one month. The results of this study are in accordance with [3] that the average intake of cadmium by the community for 30 years is 0.0000129 mg/kgxday and for 50 years is 0.00000215 mg/kgxday, where the intake for 50 years is greater than the intake for 30 years. The nature of the heavy metal cadmium that accumulates in the body, especially in the blood, will have the health impact after 10 - 30 years. A person's age will affect the body's immune system against exposure of toxic substances because the higher a person's age, the more susceptible they are to their low immune system. At old age or adulthood, the activity of the bio transform enzyme will decrease, while at a young age the level of sensitivity is higher for the activation of heavy metal cadmium [10].

Based on table 4.3, the highest value of cadmium levels is - with an average of - 0.232 g/dL in respondents aged 42 years and consumption levels 3 times in one month. The high value is caused by the level of consumption of respondents in consuming Mystus Gulilo obtained in the waters of Kenjeran Beach, Surabaya. This result is in accordance with research [11] that the greater the value of the intake rate or the level of community consumption, the greater the risk of health disorders in the community. The higher the level of consumption, the higher the exposure to cadmium in the body, and if the level of consumption is high, it can cause chronic poisoning because

the toxins contained in the metal are carried to the body and accumulate over a long period of time, so that the body's immune system cannot tolerate the presence of toxins heavy metals and impact the healthiness of the body [3]. The amount of cadmium that enters the body that exceeds the normal value will damage organs to death due to presence of metal beat cadmium [12].

The results of this study indicate that a small proportion of respondents who participated in this study, had a cadmium level value that exceeded the normal value 0.12. That 3 out of 11 respondents were exposed to cadmium with a percentage of 27.27% having an average value of 0.186 g/dL. Respondents with normal cadmium levels are 7 of 11 with a percentage of 63.63% and have an average value of cadmium levels of 0.079 g/dL. While only one respondent with a percentage of 9.09% has a value of cadmium levels below normal, which is 0.029 g/dL. Cadmium that enters the blood is caused by the presence of heavy metal, cadmium, in Mystus Gulilo that was consumed by the local communities, which is obtained directly from the waters of Kenjeran Beach, Surabaya. This result is in accordance with research [13] that Mystus Gulilo in the Ketingan river area of Sidoarjo that is also has a value that exceeds the normal of the quality standard, which is 0.1 mg/kg. Fishes that are found in Kenjeran Coastal Surabaya waters are polluted by heavy metals, one of which is cadmium. This result is in accordance with research [14] that the level of cadmium around the Kenjeran estuary in seawater is 0.0327 ppm and the sediment is 0.481 ppm which exceeds the normal limit value.

Cadmium that is contained in water and waste can enter the bioaccumulation of fish through the gills which are the main point of entrance of cadmium in fish. The cadmium is then absorbed by the gastro-intestinal tract and distributed into fish body tissues. From that, the cadmium can then also accumulates from the food chain process until it gets to humans, absorbs into blood and then binds to proteins that have low molecular weight values. The absorption process will increase, if there is a deficiency of Ca, Fe, and low protein in food. The deficiency of Ca contained in food will stimulate Ca-protein so that it will increase the absorption of cadmium [15]. Cadmium has toxic effect on the body and affects the healthiness, among others, by increasing the risk of breast cancer, cardiovascular disease, and heart disease [16]. Prevention that can be done to anticipate the dangers of heavy metals that can enter the body is to be careful in consuming food and pay more attention to food. This research protocol is ethically complaint with certificate number No. EA/412/KEPK-Poltekkes_Sby/V/2021. It is declared ethically complaint in accordance with 7 WHO 2011 standard.

CONCLUSION

The results of the study with cadmium levels are based on age with the lowest level values in people aged 40 years and the highest levels of cadmium in people aged 42 years and based on the level of consumption. The cadmium rate of consumption levels is as much as 3 times in one month, and that is also shows the highest levels of cadmium rate. The higher the age of a person, the higher the value of cadmium levels, because the levels of cadmium deposited in the body are higher. By that, the conclusion is the higher the consumption level of Mystus Gulilo, the higher the value of cadmium levels that accumulate in the body.

Referring to the results of research, discussion, and conclusions, suggestions can be made for the community to be more careful in consuming food and pay attention to eating patterns.

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