ORAL PRESENTATION

The Contents of Heavy Metals in *Plecostomus* (Loricariidae) from the Ciliwung River Jakarta, Indonesia

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Abstract

Indonesia has a life-oriented river. As much as 68 percent of the quality of river water in Indonesia is heavily polluted, including the Ciliwung River in DKI Jakarta Indonesia. The pollution can affect river ecosystems, especially river biota such as plecostomus species found in the Ciliwung River. Plecostomus that have dominated Ciliwung River are widely used by traders to be used as processed raw material products. The purpose is to identify the content of heavy metals, especially lead (Pb), mercury (Hg) and cadmium (Cd) in the flesh of plecostomus from the Ciliwung River in Jakarta. The methods employed were collecting plecostomus samples, plecostomus flesh preparation, and metals content analysis with X-Ray Fluoresence (XRF) Spectrometer. The metal results identified with the XRF method on the flesh of plecostomus as much as 57 metals and there are three types of heavy metals of Pb, Hg and Cd. The concentration of heavy metals of Pb, Hg and Cd exceeds the maximum value of SNI threshold. Therefore, plecostomus flesh from Ciliwung River Jakarta is not feasible for consumption.

Keywords: Ciliwung River, *Plecostomus*, fish flesh, heavy metals, Jakarta Indonesia.

Introduction

Rivers in Indonesia are used as a source of life, such as a place to live and to work. Around 68 percent or the majority of the river water quality in 33 provinces in Indonesia is in heavily polluted status including Ciliwung River in DKI Jakarta and its neighborhood (KLHK 2015). The quality of Ciliwung river is heavily polluted in all segments, starting from the upstream (Bogor) to the downstream (DKI Jakarta) and that makes Ciliwung river not feasible to use for any kinds of activities as it can pollute Ciliwung's River Stream Area. The pollution may affect the river ecosystems especially the river biota such as fish species in Ciliwung River.

Plecostomus is one of the species found in Ciliwung River (Hadiaty 2011). This is an introduced fish from Central America and South America which comes from Amazon River (Pound et al. 2010) brought by hobbyists, then entered into public waters in intentionally or unintentionally (Ploeg 2008). Biological and ecological fish brooms include being able to take oxygen from the air (facultative air breather) and detritus feed type (Yossa & Araujo-Lima 1998).

Nowadays, plecostomus from Ciliwung River is mostly used as the raw materials for food, such as dim sum, *empek-empek*, and fish chips (Mahdiah 2002) because plecostomus has economic value. The problem is if plecostomus lives in Ciliwung River that is polluted by metals, and consumed by people as food, it can be poisonous (DINKES 2015). Therefore, there comes the need to conduct a research about metals content in plecostomus flesh. This research is aimed at identifying the contents of heavy metals, especially lead (Pb), mercury (Hg), and cadmium (Cd) within plecostomus flesh from Ciliwung River. This is expected to give additional information about metals content in plecostomus flesh as people's food material.

Material and Methods

The research was conducted from September 2017 until October 2017. The location was at PAIR Laboratory to prepare for the samples and to analyze the results, meanwhile the employment of XRF tool to identify metals in plecostomus flesh was located at PTBGN Laboratory, National Agency of Nuclear Energy (BATAN).

1.1. Materials and Tools

Tools that were used during the sampling were containers and nets. The tools used in laboratory were knife, scissors, rulers with 1 mm precision, containers, mortar & alu, 60 ºC oven, analytical balance with 0.0001 g precision, Ziploc plastic bag sized 6x8 cm, desiccator, spatula, crucible, crucible brace, and *X-Ray Fluoresence* (XRF) tool. The materials that were used were 18 plecostomus fish which were categorized into three groups in accordance with its body size, which were small-size plecostomus fish weighed < 115 g, medium-sized plecostomus fish weighed 140-180 g, and bigger-size plecostomus fish weighed > 215-310 g.

1.2. Samples Collection

Samples collection was started with conducting a survey and raw materials sampling at the research location to gain information about the origin of plecostomus and its habitat at Ciliwung River Stream Area (Figure 1). The fish were caught using fish nets and put into containers. After that, morphometric measurement was administered covering the total length, width, and height of the fish. Some samples which had not been researched were preserved inside freezer.

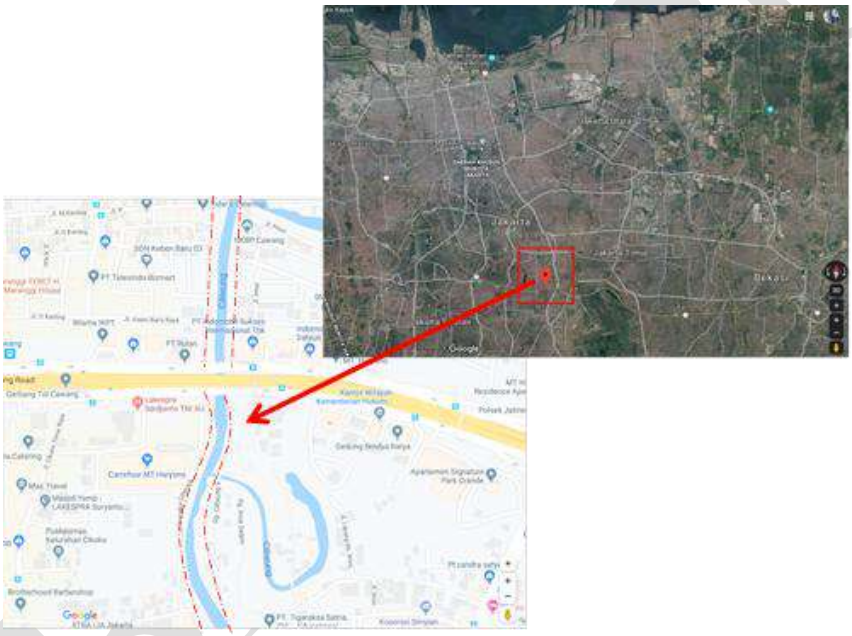

Figure 1 Sampling site Ciliwung River Stream Area Jakarta, Indonesia

1.3. Samples Preparation

The fish were dissected and were separated from its bones and skins using fillet technique. Then, the fish were weighed using analytical balance. The fish were put onto crucible and dried inside the oven for 60^0C for five days. The dried flesh were weighed again using digital balance and were crushed and were put into Ziploc plastic bag. Each plastic was given labels according to the fish size category.

1.4. The Analysis of Metals Content in Plecostomus Flesh

The dried flesh samples were filtered ± 100 mesh and were weighed for 5 grams. The analyzed samples were in the form of *press powder*. After that, the analysis of metals content in plecostomus flesh samples employing *X-Ray Fluoresence* (XRF) *Spectrometer* tool with GeoChemPellet 2 method was administered. The data gained from the analysis results using XRF were in qualitative and quantitative analyses. The results of metals measurement can be seen from the program in graphs, spectrum, and

tables. Then, the results were converted to Microsoft Excel for data processing and would be analyzed using SPSS to determine the correlation. The heavy metals were further analyzed as Pb, Hg and Cd.

Results

The identification result using XRF, it was found three heavy metals; they were Pb (Pb), mercury (Hg) and cadmium (Cd). The unidentified heavy metals were because the XRF method only analyzes metals with high concentration within the samples. Therefore, metals content in relatively low concentration cannot be detected by XRF (Suhariyono & Menry 2005). The presence of metals inside an organism's body occur because there is an accumulation of metals inside the organisms (Puspasari 2006).

Tabel 1. The result of heavy metals in pleco flesh

Heavy Metals	Pb (mg/kg)	Cd (mg/kg)	Hg (mg/kg)
Small	3.6 ± 0.3	0.6 ± 0.1	1.4 ± 0.3
Medium	2.7 ± 0.3	<0.5 ± -0.2	0.8 ± 0.3
Large	2.2 ± 0.3	<0.5 ± -0.2	0.3 ± 0.3

Discussion

The Pb concentration in three different size categories of plecostomus flesh – smaller-sized fish were for **3.6 ± 0.3** mg/kg, medium-sized fish were for **2.7 ± 0.3** mg/kg, and larger-sized fish were **2.2 ± 0.3** mg/kg (Table 1). The concentration value of Pb that was identified in three different categories of the fish flesh was > from 1 mg/kg as a safe threshold for fishery product to be able to consume and > from 0.3 of the safe threshold of consumption in fishery products (BSN 2009). Thus, it can be found that the concentration value of Pb is higher than the safe threshold value to consume.

Table 2 The comparison of Pb concentration with SNI research results

Heavy Metals / Category	Pb (mg/kg)				
	2009	2013	2017	SNI 2009	
				Flesh	Fishery Products
Small			3.6 ± 0.3		
Medium	0.02	2.88 ± 1.93	2.7 ± 0.3	1	0.3
Large			2.2 ± 0.3		

Based on research conducted by Ratmini (2009), plecostomus that were caught in Ciliwung River have 0,02 mg/kg of Pb, but the value is not higher than the set standard. However, results found in a research conducted by Alfisyahrin (2013), showed that the metal concentration of Pb in plecostomus from Ciliwung River near Bogor, Depok, and Jakarta Railway Stations were for 2.88 ± 1.93 which were higher than the set standard.

The Hg concentration in plecostomus flesh is higher than the safe threshold which is > from 0,03 mg/kg as fishery products and > from 0,5 mg/kg as fishery products, therefore it is not feasible to consume (BSN 2009). The concentration of heavy metal Hg in plecostomus flesh in three different sizes are **1,4 ± 0,3** mg/kg in smaller-sized fish, medium-sized fish for **0,8 ± 0,3** mg/kg and larger-sized fish for **0,3 ± 0,3** mg/kg (Table 2).

Table 3 The comparison of Hg metal concentration with SNI research results

Heavy Metals / Category	Hg(mg/kg)				
	2009	2013	2017	SNI 2009	
				Flesh	Fishery Products
Small			1.4 ± 0.3		
Medium	0.0005	0.001	0.8 ± 0.3	0.03	0.5
Large			0.3 ± 0.3		

The comparison result gained from Ratmini's (2009) and Hardi's (2013) research, showed that Hg concentration in plecostomus flesh in Ciliwung River was < from 0.001 thus it was still lower than the set standard from the government, but if it was consumed constantly for longer period of time, the possibility of being poisoned would occur. Consequently, alter has to be given since Hg metal is bio-accumulative (Puspasari 2006).

The concentration of Cd metal in plecostomus flesh found in three different size categories, showed that in smaller-sized fish has a concentration for **0.6 ± 0.1** mg/kg, medium-sized fish for **0.5 ± -0.2** mg/kg, and bigger-sized fish for **0.5 ± -0.2** mg/kg (Table 3). The metal concentration of Cd found in the three categories of plecostomus flesh was > from 0.3 mg/kg from the safe threshold of consumption in fishery products and > from 0.1 as a safe standard of consumption in fishery products (BSN 2009). The result showed that the concentration of Cd in plecostomus flesh is higher than the safe threshold to consume.

Table 4 The comparison of Cd metal concentration with SNI research results

Heavy Metals / Category	Cd (mg/kg)				
	2009	2013	2017	SNI 2009	
				Flesh	Fishery Products
Small			0.6 ± 0.1		
Medium	0.003	< 0.005	<0.5 ± -0.2	0.3	0.1
Large			<0.5 ± -0.2		

According to the comparison of Cd concentration value in 2017 research finding to Ratmini's (2009) and Dhika's (2013) showed that there was an increment of concentration. From 2009 until 2013, plecostomus flesh from Ciliwung River contained Cd metal concentration for < from 0.005 mg/kg thus it was still lower than the set standard by the government (Table 4). However, in 2017, the Cd concentration was higher than the set standard by the government for > from 0.3 mg/kg as fishery products and > from 0.1 as fishery products. Therefore, plecostomus flesh is not feasible to consume by people (BSN 2009).

The concentration contents of heavy metals of Pb, Hg and Cd from 2009 until 2017 has been increasing inside plecostomus flesh. Increased metal content can be caused by seasonal differences each year (Olojo et al. 2012). Based on the investigation at the sampling area exactly around Ciliwung Riverbank in Jln. Inpeksi Ciliwung Letjen MT. Haryonoo, the stream condition of the water at the sampling location is not too big since the water is black and much of garbage is found alongside the riverbank.

So, the identified metals using XRF method in plecostomus flesh are 57 metals with certain concentration value and there are three types of heavy metals such as Pb, Hg and Cd. The highest heavy metal concentration of Pb, Hg and Cd is in smaller-sized fish for 3.6 ± 0.3 mg/kg of Pb, Hg 1.4 ± 0.3 mg/kg and Cd 0.6 ± 0.1 mg/kg. The heavy metals concentration of Pb, Hg and Cd has always been increasing from 2009, 2013, and 2017 and it has beyond the maximum value of SNI of being feasible to consume status for meat and fishery products, thus plecostomus flesh from River Stream Area of Ciliwung Jakarta is not feasible to consume.

Construction projects, industries, and number of vehicles every year have become the main trigger in the increasing value of heavy metal concentration in Ciliwung River. In addition, the changes in the use of land and more population along the riverbank have implied towards pollutants' addition to Ciliwung River. This finding is supported by research conducted by Taufik (2003) that the sources of pollution in Ciliwung River Jakarta are coming from kinds of activities of the people living close to it and industries. Therefore, the dangerous heavy metal sources such as Pb, Hg and Cd are suspected to come from the

waste of construction projects, industries, residential areas, and transportations along the riverbank which can pollute the river ecosystems especially river biota such as plecostomus in Ciliwung River.

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