



The 3rd International Conference on Halal, Policy, Culture and Sustainability Issues

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Analysis concentration of Mercury (Hg) and Lead (Pb) in the Fish (*Oreochromis niloticus*) and Shellfish (*Perna viridis*) and Neurophysiologic Symptoms to The Community around The Tello River, Makassar, Indonesia

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Abstract

Background: Heavy metals released into the marine environment can destroy both biodiversity and ecosystem because of their toxicity and trend accumulative in the aquatic biota and pose a risk to fish consumers, such as humans and other wildlife. The toxicity of heavy metals such as Pb, Hg, Cd, Cu, Zn, As, Fe, and Cd is known to cause various neurological disorders in adults, including cerebellar dysfunction, altered mental status, and various motor, sensory, and ophthalmologic abnormality.

Objectives: The research aims to determine of concentration mercury (Hg) and Lead (Pb) in the fish (*Oreochromis niloticus*) and Shellfish (*Perna viridis*) and the effect of neurophysiologic symptoms.

Material and Method: The method of this study is to analyze of concentration of Hg and Pb using atomic absorption spectrometry and the assessment of neurophysiologic symptoms is using a questionnaire.

Result and Discussion: The result of the study shows the concentration of Pb and Hg in the *Oreochromis niloticus* and *Perna viridis* in three points (1,2, and 3) that found of Pb concentrations in the fish namely the point 1 is 0.043 µg/gr, 0.025 µg/gr, is 0.01 µg/gr, respectively. The *Perna viridis* of Hg concentration is three points namely point 1 is 0.00142 µg/gr, point 2 is 0.0035 µg/gr, and point 3 is 0.0037 µg/gr. The *Perna viridis* Pb concentrations we found the three points namely the point 1 is 0,0223 µg/g, point 2 is 0,0283 µg/g and point 3 is 0,0278 µg/g. The Hg concentration of fish (*Oreochromis niloticus*) the all of the points is < 0.0005 µg/gr. The neuropsychological symptoms in the community in Tallo Village, Tallo District, Makassar City found respondents with severe symptoms as many as 18 people (58.1%) and 13 people with mild symptoms (41.9%). There are about 31 consumers who experience neuropsychological symptoms, this is because commonly they consume fish and shellfish as foods that are high protein since they were children so that the biomagnification process occurs. The statistic analysis also shows the correlation between frequency consumption and Neurophysiologic Symptoms. Both heavy metals have accumulated in the body so that detoxification process. The statistical analysis also shows the significant correlation between duration of consumption and Neurophysiologic Symptoms. Because of the long time they consume so the occurring of bioaccumulation and biomagnification process in the body due to intoxication of the heavy metals.

Conclusion: The conclusion in this study was that although fish and shellfish had normal concentrations, it was found that people who consumed fish and shellfish experienced neuropsychological symptoms, this may be due to the biomagnification process.

Keywords; Mercury (Hg), Lead (Pb), Fish (*Oreochromis niloticus*), Shellfish (*Perna viridis*), Neurophysiologic Symptoms



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1. Introduction

Heavy metals released into the marine environment can destroy both biodiversity and the ecosystem because of their toxicity and trend accumulative in the aquatic biota and pose a risk to fish consumers, such as humans and other wildlife[1].

The toxicity of heavy metals such as Pb, Hg, Cd, Cu, Zn, As, Fe and Cr is known to cause various neurological disorders in adults, including cerebellar dysfunction, altered mental status, and various motor, sensory, and ophthalmologic abnormality[2].

The effect of humans health for Symptoms of lead toxicity in adults include fatigue, anorexia, irritability, abdominal pain, muscle weakness, and peripheral neuropathy. Long-term deficits in memory and psychomotor function, depression, and hostility have been observed in individuals who are occupationally exposed to lead. For example the incidence of “Roman Mental” in The Roman used of lead extensively[2]–[10].

Minamata disease, which is an example of industrial pollution in Japan, was first discovered around Minamata Bay in Kumamoto Prefecture in 1956. After 12 years of investigation, the government announced its opinion that neurological damage suffered in over 12,000 people in Kumamoto and Kagoshima prefectures was due to the toxicity of methyl-mercury compounds discharged from a chemical plant. Beginning in the Taiso period (1912–1926), pollution of the ocean by the wastewater from the Chisso factory occasionally became a problem. However, from 1932 to 1968 the company continued to use inorganic mercury as a catalyst in producing acetaldehyde, which was used to produce acetic acid and vinyl chloride. Methyl mercury, an untreated by-product of the production process, was discharged into the sea until 1966[11], [12].

This compound modified the natural elements and the organism in the ecosystem of Minamata bay like fish and shellfish. By consuming a large quantity of fish and shellfish from the sea, the methylmercury entered the human body. Some early severe victims of the disease became unconscious and died within a month of the onset of the disease. Mercury disaster in Minamata does teach us the interdependence of people, soil, rivers, and sea.

Pollution of the Tallo River generally comes from various sources, mainly from surrounding settlements and companies that dump their waste into the river, namely Tallo Steam Power Plant (PLTU), PT IA, PT SWT, PTMT, PT KTC, and Ibnu Sina Hospital.

The results of concentration Pb in the Tallo River for stations as a whole ranged from 1.2 mg/kg to 1.6 mg/kg. The highest concentration Pb is 1.6 mg/kg at station 2 (St. 2). The high concentration of lead in St. 3 is due to the presence of fishermen's settlements and shipping activities, the waste generated from households mostly consists of soap, plastic, paint, and oil, especially shipping activities that produce a lot of Pb in water bodies. Motorized fishing boats, which are mostly owned by fishermen who live on the outskirts of the Tallo River, use active anti-explosion consisting of tetramethyl and tetraethyl Pb or a combination of both, the Pb component will react and form gas when the engine is running[13]–[18]. This happens because the activity and mobility of traditional boats are relatively smooth in and out of the river and leave the waste in the form of liquids and oil spills which are then deposited (accumulated) in green mussels. The purpose study is to analyze the concentration of Pb dan



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Hg in the mussels and the effect of Neurophysiologic symptoms on the humans of the surrounding Tello river Makassar.

2. Research Method

The research method is observational analytic and the cross-sectional design. The analysis of concentration Pb dan Hg is Atomic Absorption Spectrophotometer (AAS). Assessing neuropsychologic symptoms is questionnaire base on the UNEP[1], [19].

3. Result and Discussion

3.1. The Pb and Hg concentration in shellfish

The concentration of Hg in fish was found that the concentration in all areas was still within normal levels or not polluted by Hg metal. Meanwhile, the highest concentration of Hg in shellfish was found in the area of points 2 and 3, namely 0.004 ppm while in the area of point 1 it was found to be 0.001 ppm.

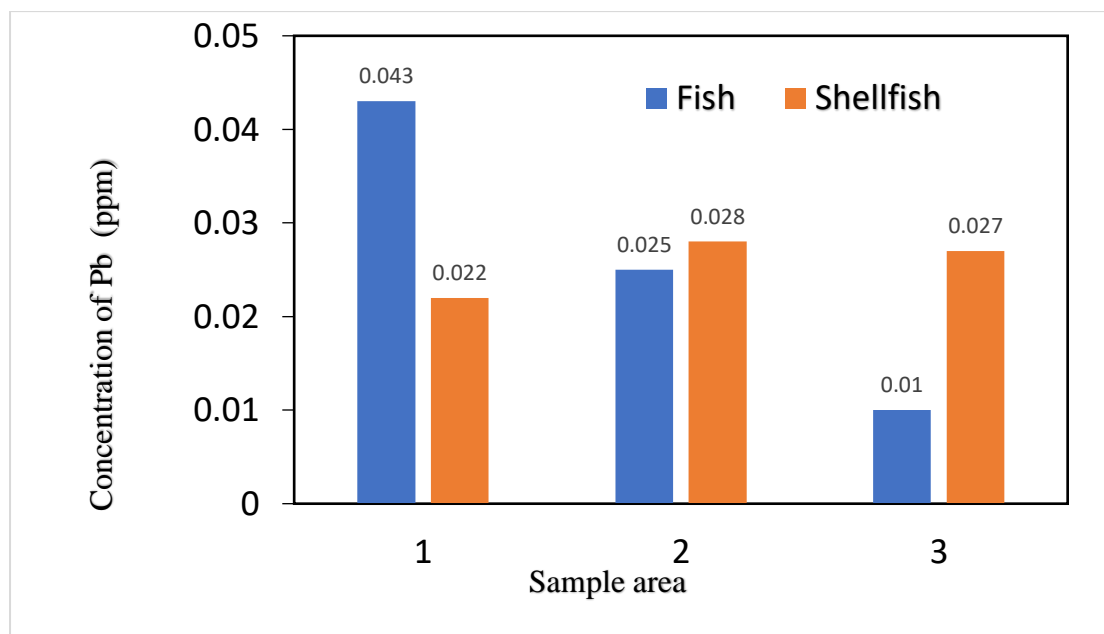


Figure 1. The concentration of Pb in fish and shellfish in the Tallo river, Makassar City



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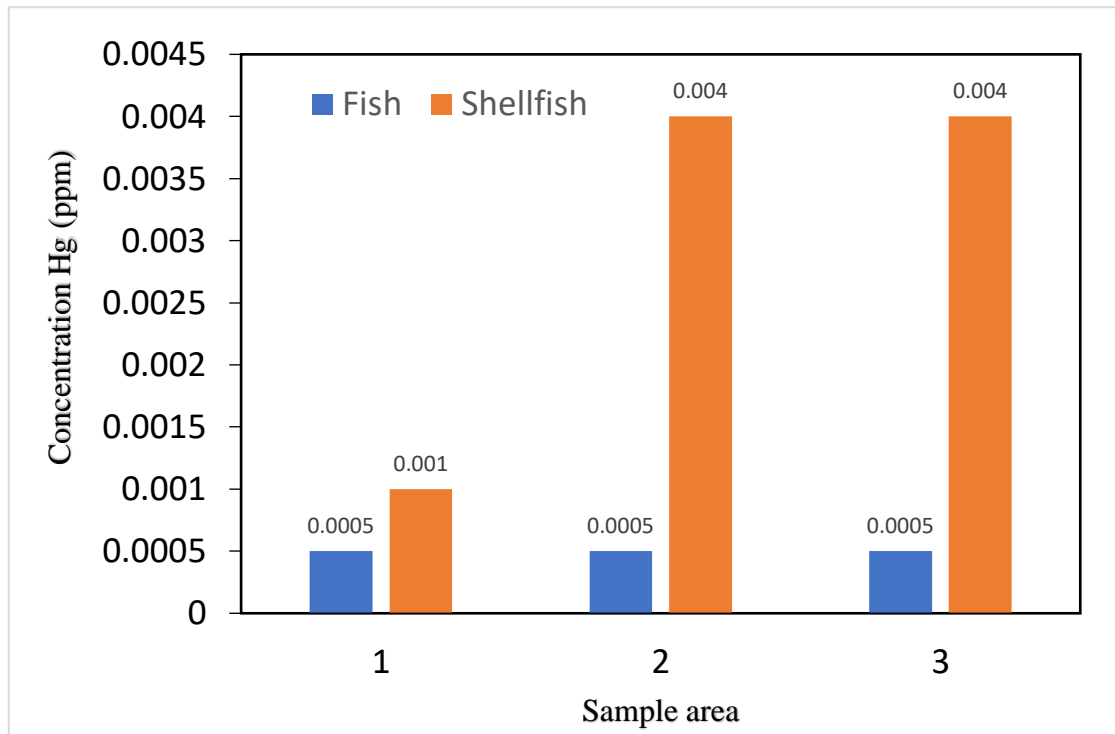


Figure 2. The concentration of Hg in fish and shellfish in the Tallo river, Makassar City

Based on BPOM No. 03725/B/SK/VII/1989/FAO/WHO 1076, the concentration of Hg and Pb in food is 0.0005 ppm. Based on the results of the analysis that the concentration of Pb in fish and shellfish was declared unqualified in this case contaminated with Pb. While the concentration of Hg in fish at the three points has not been polluted but the concentration of Pb in shellfish has been polluted by Pb metal[20]–[24].

3.2. The Relationship Between Age and Neurophysiologic Symptoms

The distribution of respondents based on age, the highest is age <50 years as many as 26 people (83.9%) and the lowest is age 50 years as many as 5 people (16.1%). While the distribution of respondents based on gender, the highest was 22 people (71.0%) and the lowest was 9 people (29.0%). Based on graph 1 and graph 2 the Pb content in fish and shellfish was found that the highest concentration in fish at point 1 was 0.043 ppm, then at point 2 was 0.025 ppm, and the lowest at point 3 area was 0.01. While the concentration of shellfish was found that the highest concentration was found at points 2 and 3, namely 0.027 and 0.028 ppm, and the lowest was found at point 1, namely 0.022 ppm.

Based on table 1 shows that respondents aged <50 years with mild neuropsychological symptoms as many as 12 people (46.2%) and 14 people with severe symptoms (53.8%). Meanwhile, 1 person (20.0%) with mild neuropsychological symptoms and 4 (80.0%). Based on the results of the Pearson chi-square test, a significant value (p value) = 0.001 where <0.05 means that there is a relationship between age and neuropsychological symptoms in the community around the Tallo River, Makassar



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City. This is because commonly they consume fish and shellfish as foods that are high protein since they were children so the biomagnification process occurs [17], [25], [26].

Table 1. The Relationship Between Age and Neurophysiologic Symptoms

Age (year)	<i>Neurophysiologic Symptoms</i>				Total		ρ value
	Mild symptoms		Severe symptoms		n	%	
	n	%	n	%			
<50	12	46.2	14	53.8	26	100	0,001
\geq 50	1	20.0	4	80.0	5	100	
Total	13	41.9	18	58.1	31	100	

3.3. The relationship between the frequency of consumption of shellfish with *neuropsychological symptoms*

Based on table 3 shows the distribution of respondents based on the frequency of consumption of shellfish <3 times a week with mild neuropsychological symptoms as many as 9 people (45.0%) and 11 people with severe symptoms (55.0%). Meanwhile, the frequency of consumption of shellfish 3 times a week with mild neuropsychological symptoms was 4 people (36.4%) and 7 people (63.6%).

Based on the results of the Pearson chi-square test, a significant value (ρ value) = 0.003 where <0.05 means that there is a relationship between the frequency of shellfish consumption and neuropsychological symptoms in the community around the Tallo River, Makassar City.

Table 2. The relationship between the frequency of consumption of shellfish with *neuropsychological symptoms*

Frequency of consumption (per week)	<i>Neurophysiologic Symptoms</i>				Total		ρ value
	Mild symptoms		Severe symptoms		n	%	
	n	%	n	%			
<3 kali	9	45.0	11	55.0	20	100	0, 003
\geq 3 kali	4	36.4	7	63.6	11	100	
Total	13	41.9	18	58.1	31	100	

They are exposed to mercury and lead in shellfish, which can be cause neuropsychological effects. Both heavy metals have accumulated in the body so that the detoxification process [27], [28].

3.4. The relationship between the duration of consumption of shellfish with *neuropsychological symptoms*



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Based on table 3 shows the distribution of respondents based on the duration of consumption of shellfish for <5 years with mild neuropsychological symptoms as many as 8 people (61.5%) and severe symptoms as many as 5 people (51.3%). Meanwhile, consumption of shellfish for 5 years with mild neuropsychological symptoms was 5 people (27.8%) and 13 people had severe symptoms (72.2%). Based on the results of the Pearson chi-square test, a significant value (ρ value) = 0.004 where <0.05 means that there is a relationship between the length of shellfish consumption and neuropsychological symptoms in the community around the Tallo River, Makassar City.

Table 3. The relationship between the duration of consumption of shellfish with *neuropsychological symptoms*

Duration of consumption (per week)	<i>Neurophysiologic Symptoms</i>				Total		ρ value
	Mild symptoms		Severe symptoms		n	%	
	n	%	n	%			
<3 kali	8	61.5	5	51.3	20	100	0, 003
≥ 3 kali	5	27.8	13	72.2	11	100	
Total	13	41.9	18	58.1	31	100	

They are exposed to mercury and lead in fish and shellfish, which can be cause neuropsychological effects. Because of the long time they consume so the occurring of bioaccumulation and biomagnification process in the body due to intoxication of the heavy metals[14], [15], [28], [29].

4. Conclusions

The Pb concentration into the Fish and Shellfish have been contaminated in three areas at the Tallo river, While the Hg concentration in the fish is still normal is mean is not contaminated, but the Hg into the Shellfish has been contaminated. The consumers of food have been showing neuropsychologic symptoms. They have undergone a process of accumulation and biomagnification in their bodies. This is also proven by statistical analysis that there is a relationship between age, frequency, and duration of consumption on the neuropsychology effects.

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