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Chromium (Cr) Content in Green Mussels (*Pernaviridis Linnaeus*): Case Study at 10 Markets in Semarang City, Central Java, Indonesia

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Abstract. In terms of maintaining food safety for continuing national development, it is important to put in concern toward food especially those who caught from the sea (seafood), including green mussels (*Perna viridis Linnaeus*); from the dangerous threat of heavy metals. This research was aimed to analyze the content of Chromium in green mussels (*Perna viridis Linnaeus*) bought from several traditional markets in Semarang, Central Java, that had been done in February 2014 - April 2014. This research was done with systematic random sampling methods at 10 traditional markets in Semarang. The data was analyzed with Descriptive Analysis in ways of comparing the Chromium (Cr) content in green mussels based on a guideline of Food and Drug Administration. Test of heavy metal content was analyzed using Atomic Absorption Spectrophotometer (AAS) in Laboratory of Chemical Analysis, Diponegoro University, Semarang. The results showed that the content of Chromium (Cr) in green mussels range from 0.93 ppm – 2.40 ppm and still below of United States FDA standards, which is 13 ppm. However, daily value allowed for consuming Chromium is 0.13 ppm, so that green mussels from Semarang are not recommended to consume every day.

Keywords: chromium (Cr), green mussels (*Perna viridis Linnaeus*), Semarang traditional markets

1. Introduction

The rapid growth of industries in Semarang causes environmental pollution, including water pollution ecosystem in the area around those industries. This pollution causes the decrease of water qualities physically, chemically, and also biologically. A polluted water can contaminated the living biota in the area, so that it can caused negative to the living biota, such as fishes, herrings, and others as consumery foods [1].

A very potential contaminer comes from heavy metal waste, including Pb, Cd, and also Cr [2], will be accumulated in biota, one of them are green mussels (*Perna viridis*). This is because the green mussel's eating process is by filtering its food or usually called "filter feeder". Green mussels habitude usually like to settle down or caled "*ceccile*" and they are not belong to migratory organisms, thus this biota often used as accumulated heavy metal monitoring animal on sea organisms. One of the dangerous heavy metal is Chromium (Cr) that is non essential neurotoxic heavy metal and could cause bioaccumulated. Cr could be accumulated in organisms on a long time as an accumulated poison [3].

The species of green mussels (*Perna viridis*) sold in several traditional markets in Semarang commonly comes from Semarang northern beach, so that it needs a further research whether that green mussels contaminated by heavy metals, especially Cr and does the bioaccumulated that happened higher than United States FDA 2009 standards.

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2. Materials and Methods

2.1. Sampling method

This research began on February until April 2014. Samples collected using systematic random sampling at 10 traditional markets in Semarang, which deemed represents many sub urbans around Semarang, Central Java. Those are Langgar traditional market, Karang Ayu traditional market, Johar traditional market, Genuk traditional market, Gayamasari traditional market, Boom Lama traditional market, Peterongan traditional market, Banyumanik traditional market, Pedurungan traditional market, and Sampangan traditional market. Samples that bought from those traditional markets are 500 gr of green mussels for each market. Then the samples were put into plastic bags and washed to clean up the mussels off of stones, gravels, and dirt remained. Samples were boiled to sepparate the shells and its muscle. 50 gr of its muscle were taken and put it in the oven at temperature of 100 ℃ to gain the dry weight.

2.2. Chromium analysis

Samples then analyzed to determine the Cr content using *Atomic Absorption Spectrophotometer* (AAS) [4] in Laboratory of Chemical Analysis, Diponegoro University, Semarang. The data analysis of Chromium content, descriptive-quantitatively is the content of Chromium that will be compare with the [5] standards.

2.2.1. Preparation of the standard iron solutions

Five standard solutions were prepared covering the range 2-16 μg/ml in 100 ml volumetric flasks. One of the solutions should contain 5.0 μg/ml of iron. This solution is used to check the performance of the instrument. To make up the five standard solutions, one stock solution (0.1000g/1000 ml) was made and diluted of it aliquots. The iron wire was then cleaned with emery cloth and dissolve the wire in a minimum amount of a 1:1 v/v mixture of concentrated nitric acid and water. Heating will be necessary but boiling during the dissolving process should be avoided. When the iron wire is dissolved the solution boil briefly to remove oxides of nitrogen. The solution then transferred quantitatvely to a 1000-ml volumetric flask and dilute to volume with distilled water. The volumetric pipettes were used to take aliquots of the stock solution. The aliquots then delivered to 100-ml volumetric flasks and dilute to volume with distilled water.

2.2.2. Preparation of the sample solutions

Four copper-based alloy samples were received to analyze for the iron content. The first sample will be a standard sample of known iron content. Amount of iron were calculated in a 100-ml volumetric flask whose concentration lies in the middle of the standard solution concentrations. The second sample was prepared unknown sample. The third and fourth samples were objected from approximately 0.2 g from object #1 and 0.1 g from object #2 to prepare solutions in 100-ml volumetric flasks. All four samples were weighed to 0.1 mg with gentle heating, dissolve each weighed sample in a 250-ml beaker with a 1:1 v/v mixture of concentrated hydrochloric acid and water. A minimum amount of a 1:1 v/v mixture was added concentratic nitric acid and water to aid in the dissolving process. Avoid boiling during the dissolving process; When the sample was dissolved, oxides of nitrogen were removed with boil briefly. The sample solutions were transferred to the appropriate volumetric flasks and diluted to volume with distilled water.

2.2.3. Preparation of the instrument

Iron lamp has been installed in the instrument and that water was present in the drain system float assembly container. The vent was opened for the exhaust above the instrument and closed the hood door. The acetylene tank pressure should be 75 psi or greater. The monochromator were set to 248.3 nm, the slit width to 0.2, and the slit height to HIGH.

2.2.4. Measurement of absorbance

5 test tubes provided were filled with blank solution (distilled water), wash solution (distilled water), the standards in order of increasing concentration, and the samples. For a given run attempt to place the capillary aspiration tubing in a reproducible manner in each test tube and try to have the height of the solution the same in each test tube.

3. Result and Discussions

Green mussel (*Perna viridis*) is one of many herrings commonly live in sea. It usually live by sticking on a rough substrates such as woods, stones, or hard mud with their "*byssus".* Green mussel has a thin shells, which are symmetric and also its umbo bends forward. The shells' size is longer than its umbo [6].

Green mussel's habitude usually like to settle down in the sea substrates and its eating process is by filtering its food, so that they have ability to accumulate pollutants such as bacteria and heavy metals. For that reason, this bivalve is able to accumulate a high amount of Chromium as found in several traditional markets in Semarang (Table 1).

Table 1: Analyzed Result of Chromium (Cr) Content in Green Mussels (*Perna viridis Linnaeus*)

Samples code	Read 1 (ppm)	Read 2 (ppm)	Read 3 (ppm)	Mean Cr±SD (ppm)
Langgar traditional market	1.20	0.96	0.96	0.96±0.14
Karang Ayu traditional market	2.50	2.2	2.04	2.27±0.23
Johar traditional market	1.92	1.44	1.44	1.68±0.28
Genuk traditional market	0.69	0.93	0.69	0.92±0.13
Gayamsari traditional market	1.90	2.38	2.14	2.14±0.24
Bom Lama traditional market	2.06	2.06	2.52	2.29±0.26
Peterongan traditional market	2.34	2.34	2.34	2.33±0.00
Banyumanik traditional market	2.40	2.70	2.70	2.40±0.17
Pedurungan traditional market	1.90	2.14	1.67	1.90±0.24
Sampangan traditional market	1.69	1.45	1.46	1.45±0.14

In fact, green mussel is a herring that has a high nutrition value which can help maintaining people's health and support in preventing the intestine cancer. It is also a good source of vitamin B12 that contributes in forming red blood cells and needed to take part in carbohydrate, fat, and protein metabolisms. Green mussels containing Omega-3 fatty acids which can decrease pre-mensturation syndrome risks, slower tumor and cancer growth, preventing arthritis and over ride skin disorder. Nowadays, lots of green mussels exported to another countries, especially to European countries, Banten and Cirebon are models of successful domestic regions in cultivating green mussel.

However, Chromiun pollution happened especially in aquatic environment causes those heavy metal accumulated in the green mussels, as shown in Table 1. Chromium is an undecomposed or unbroken metalon ± 100 ℃ cooked food, because according to elements periodic system (EPU) it is known that Cr is possible to evaporate at temperature of 2000 ℃ or more. Consumption of herrings that contains Cr more than 0.13 ppm/day it will be worried to make Cr bioaccumulation in the living organisms that consume it. Too much Cr concentrated in body will cause cancer, because Cr in human's body can inhibit benzopyrene hydroxilase enzyme's operation [7]. Benzopyrene hydroxilase enzyme's function is to manage cell growth. The inhibition act of enzyme causes scaling up on replication of DNA [8] with the result the cell grows uncontrolled (cancer).

Cr is a neurotoxin heavy metal that possible to accumulate in human and animals body so that it can endanger the body day by day. According to [9], Cr is generally considered as an accumulative poison depends on its level. Chromium that dissolves in waters at certain concentration rate will be change its functions into source of poison for aquatic organism lives inside. The poisoning stage caused by Chromium is different for one to another marine biota, yet destruction of one group ecosystem will break the chain life.

Most of Chromiun pollution that happened in aquatic environment are coming from human's activities through those metal's extraction and exploitation, such as industrial waste disposal, etc. Cr usually entering the body and then undergo a process of biotransformation and bioaccumulation in the living organisms, when they consume food that contaminated by those metal. The chromium content in the tissue increases gradually, in line with the rise of chromium concentration in the water and the duration organism lives in

chromium-polluted water. It is because aquatic organisms are not able to regulate Chromium which enters their bodies [10].

According to the result, Chromium content in green mussels collected from 10 traditional markets in Semarang, range from 0.93 ppm – 2.40 ppm. If it is compare with United States FDA 2009 standards, maximum content of Chromium in herrings are 13 ppm, which means green mussels from several traditional markets in Semarang is still below of the standards. However, daily value allowed for consuming Cr is 0.13 ppm so that green mussels from Semarang are not recommended to consume everyday**.** According to FDA standards, the Chromium content in this research's samples was still below of the standards. Based on the data above, it required to do further treatment on green mussels that bought from traditional markets in Semarang, such as applying purification process, so that those green mussels are Chromium free.

4. Conclusion

Green mussels from 10 traditional markets in Semarang contaied Chromium (Cr), but it is not higher than United States FDA 2009 standards. Chromium (Cr) is a very dangerous neurotoxin heavy metal, so that if we want to consume green mussels from Semarang, it needs to be purified first. It is necessary to do a continued research on marketing chain system of green mussels which contains chromium, from the sources to the consumers. It is necessary to do further research on applying the best handling process such as purification, to green mussels so that it will be safe to consume and does not contain any heavy metals especially Chromium.

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