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Removal of Heavy Metals from a Contaminated Green Mussel [*Perna viridis* (Linneaus, 1758)] using Acetic Acid as Chelating Agents

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Abstract

Dried green mussel [*Perna viridis*, (Linneaus, 1758)] was soaked in acetic acid solution at a concentration of 10 %, 15 %, 20 %, and 25 % for 0 min, 30 min, 60 min, and 90 min. The content of heavy metals such as Pb, Cr, and Cd after soaking were analyzed by *Atomic Absorption Spectrometer* (AAS). The results indicated that after soaking in acetic acid solution at a concentration of 25 % for 90 min reducing heavy metal Pb from 2.879 $\mu g \cdot g^{-1}$ to 1.407 $\mu g \cdot g^{-1}$, Cr from 0.730 $\mu g \cdot g^{-1}$ to 0.362 $\mu g \cdot g^{-1}$, and Cd from 0.710 $\mu g \cdot g^{-1}$ to 0.441 $\mu g \cdot g^{-1}$. The increasing concentration of acetic acid solution and the longer soaking time, the levels of heavy metals (Pb, Cr, Cd) in green mussel will decreasing. Interestingly, acetic acid was able to chelate the studied heavy metals in green mussel.

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Keywords: Acetic acid solution; green mussel [*Perna viridis*, (Linneaus, 1758)]; heavy metal.

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1. Introduction

Green mussel [*Perna viridis* (Linneaus, 1758)] is a commercially important bivalve. Bivalves are filter feeder feeding on phytoplankton, zooplankton, and other orgaic materials. Increased levels of heavy metals in seawater will be followed by increased levels of heavy metals in marine biota, one of which is the green mussel. Kahle and Zauke (2002) had reported that some aquatic organisms having the ability to concentrate contaminants in their tissue and organ systems to more than a million times, compared to their concentration in their habitat. Mussel as a filter feeder is accumulates huge amounts of toxic pollutants mainly heavy metals from its habitat. Effluents arising from human activities, infrastructure developments, agricultural activities, tourism, and allied activities are the major source of heavy metal contamination of mussel growing areas.

Heavy metals could be classified as potentially toxic (e.g arsenic, cadmium, lead, mercury), probably essential (e.g copper, zinc, iron, manganese). Toxic elements could be harmful even in low concentration when ingested over a long time period. The essential metals could also produce toxic effect when their intake is excessive (Uluozlu et al., 2007). Furthermore, through the food chain will cause acute and chronic poisoning, even carcinogenic to humans who eat the shellfish. One easy way to do by the consumer of shells to reduce the influx of heavy metals including Pb, Cd, and Cr is a way of purification.

Metal dissolution by organic acids is likely to be more representative of a mobile metal fraction that is available to plants. The chelating organic acids are able to dislodge the exchangeable, carbonate, and reducible fractions of heavy metals via washing procedures (Labanowski et al., 2008). Sodium acetat is able to chelate the heavy metals (As, Pb, Cd, and Ni) in green mussel to levels permissible for human (Azelee et al., 2014).

Purpose of the study is to develop method that could safely remove heavy metals (Pb, Cr, and Cd) from contaminated green mussel by soaking in a solution of acetic acid. This study examines the potential of acetic acid solution for purification of lead (Pb), Chromium (Cr), and Cadmium (Cd) in green mussel.

2. Material and methods

2.1. Sample preparations

Green mussel was purchased from markets in Semarang, Central Java, Indonesia. Samples of green mussel was washed, then boiled to separate their shells and meat. The meat was dried at a temperature of 100 °C to obtain the dry weight. Dried meat of green mussel was soaked in a solution of acetic acid at a concentration of 10 %, 15 %, 20 %, and 25 % for 0 min, 30 min, 60 min, and 90 min.

2.2. Heavy metals analysis

The heavy metals such as Pb, Cr and Cd of green mussel meat were analyzed by *Atomic Absorption Spectrometer* (AAS) in the Laboratory of Analytical Chemistry, Faculty of Science and Mathematics, Diponegoro University. Samples (500 mg) were dissolved and 1 mL of nitric acid and perchloric acid and 2.5 mL distilled water were added. Then put in a microwave and analyzed using AAS. This method worked by comparing the absorbance of the sample solution with standard solution to obtain the sample concentration. AAS absorbances was calibrated with a standard series of unknown concentration. The results of the analysis was a calibration curve.

2.3. Statistical analysis

The differences between the mean values of multiple groups were analyzed by one-way analysis of variance (ANOVA) with Tukey methods range test. ANOVA data with a $P < 0{,}05$ was classified as statistically significant. SPSS 17 software were used.