

# The Effectiveness of Washing and Boiling Process to Reduce The Level of Lead (Pb) Within freshwater Mussel (*Pilsbryconcha Exilis*) Meat in Dam Ramanwaters North Metro Lampung

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**Abstract.** This research is conducted to determine the effectiveness of washing and boiling process to reduce the level of lead (Pb) in freshwater mussel (*Pilsbryconcha exilis*) in the waters of DAM Raman Metro city of Lampung. The sample in this study was 800 grams of freshwater mussel meat, divided into two treatments with four replications. The analysis was carried out in the Analytical Chemistry Laboratory of the University of Muhammadiyah Malang. The Pb heavy metal testing procedure referred to SNI 7387: 2009 and used an Atomic Absorption Spectrophotometer (AAS) examination. Based on the results of the analysis, it was found that Pb heavy metal content in freshwater mussel control sample is 0.080 ppm; after washing and boiling there was a significant decrease of 40%, which is 0.046 ppm. These numbers are still below the threshold value set by the 2009 National Standardization Agency. Nevertheless, they still need to be managed, because Pb can be bioaccumulated, biomagnified, but difficult to be degraded, thus potentially reducing the role of *Pilsbryconcha exilis* as a high nutritious healthy food.

**Keywords:** Boiling, Freshwater Mussel (*Pilsbryconcha Exilis*), Lead (Pb), Heavy, Washing, Metal

## 1 Introduction

Freshwater mussels are one of the animal-sourced food that high in nutrient content such as protein, amino acids, and omega 3 fats, which are good for health. Moreover, they also contain minerals such as zinc, iodine, iron, and selenium, which are needed by human body. The calcium content in freshwater mussels is even higher than it in milk and meats. Consuming freshwater mussel is recommended, considering the nutrients and minerals contained are good for the health.

Naturally, freshwater mussel is a highly nutritious food. Ironically, it has the ability of non-selective filter feeders and sessile (permanent), thus the mussels are susceptible to

pollution. One of the pollutants to watch out for is the presence of lead. In the water leads are mostly in the form of ions which can be directly absorbed directly by freshwater mussel through water passing through the gill membrane and feed [1]. Freshwater mussel can accommodate heavy metals in its body without disturbing the system itself [1]. Pb (lead) and its compounds naturally can get into the waters as a result of human activities [2]. State there are various forms of human activities caused lead entry such as industrial, household, agricultural and tourism activities [2]. In the DAM Raman itself, potential sources of Pb heavy metal pollutants come from agricultural cultivation that uses pesticides, inorganic fertilizers, molluscicides. It also come from transportation, tourist sites, and household waste.

The abundance of freshwater in the waters of Raman Dam has a positive impact on the community. People can benefit from consuming mussels at affordable prices. Considering the nutrition and minerals contained in the freshwater mussels, it is necessary to have proper handling, so that lead exposed freshwater mussels can be consumed and the community get the benefits for their health. The treatment that can be done is washing the mussel mussels with clean and running water within certain duration followed by are boiling process.

Therefore, the purpose of this study is to determine the effectiveness of washing and boiling process to reduce the level of lead (Pb) in freshwater mussel meats, so that freshwater mussels exposed to lead are safe for human consumption.

## 2 Method

The location of the study was in the area of 28 Purwosari, North Metro, Metro, Lampung. It is an experimental research using Completely Randomized Design (CRD). The research method used is Purposive Sampling, which is determining the sample with certain considerations to provide maximum data.

The population of this study are all freshwater mussels, which are found DAM Raman, Purwoasri 28 North Metro, Lampung. There are 100 grams/sample in each replication. The material used in this study are freshwater mussel meats, taken from the waters of DAM Raman, Metro, Lampung. As for the tools used in this study are the basin, bowl, knife, balance sheet, steel pan, gas stove, drainage, and adhesive plastic for sample packaging.

Firstly, the freshwater mussels are separated from the shell. The loose freshwater mussel meat then are weighed 100 grams/replication, prepared for eight replications. Then the freshwater mussels are cut into small pieces. Four replications of the mussel shells sample is used for control (unprocessed), with various duration of washing (5 seconds, 10 seconds and 15 seconds). Four others are prepared for boiling treatment, also with similar various duration of washing. Furthermore, the data is analyzed using Variance Analysis and LSD further testing, to determine the most appropriate washing and processing methods.

**Table 1.** Treatment of freshwater mussels

| Fresh | Boiled |
|-------|--------|
| A0    | B0     |
| A1    | B1     |
| A2    | B2     |
| A3    | B3     |

Information :

A: fresh (unprocessed)

B: boiled

0: not washed (as a control)

1: washed 5 seconds

2: washed 10 seconds

3: washed 15 seconds

As mentioned before, there are two treatments in this research, washing and boiling as labelled in Table 1. Washed freshwater mussel meats then boiled for 2 minutes in boiling water, right after the water is two-minute boiling(100°C).

The treated samples then are analyzed using Atomic Absorption Spectrophotometer (AAS) in the Analytical Chemistry Laboratory of the University of Muhammadiyah Malang. To keep the sample from being damaged during the trip, the samples are frozen and packed with sodium benzoate.

### 3 Results and Discussion

#### a. Results

Based on the analysis of Pb heavy metals carried out using AAS in Analytical Chemistry Laboratory at Muhammadiyah University of Malang, the data in table 2 are obtained. Each sample treated in four times of replications.

**Table 2.** The Analysis Result of Pb decline (ppm)

| Treatment | Rep.1    | Rep.2    | Rep.3    | Rep.4    |
|-----------|----------|----------|----------|----------|
| A0        | 0.080681 | 0.079589 | 0.078863 | 0.077898 |
| A1        | 0.079337 | 0.078737 | 0.077533 | 0.076951 |
| A2        | 0.077027 | 0.077502 | 0.075012 | 0.074734 |
| A3        | 0.075132 | 0.075651 | 0.073226 | 0.072884 |
| B0        | 0.054100 | 0.053161 | 0.052108 | 0.051347 |
| B1        | 0.052702 | 0.052223 | 0.050878 | 0.050368 |
| B2        | 0.050399 | 0.050908 | 0.048477 | 0.048106 |
| B3        | 0.048535 | 0.048925 | 0.046749 | 0.046216 |

Information :

A: Fresh (unprocessed)

B: Boiled

0: Not washed (as a control)

1: Wash 5 seconds

2: Washed 10 seconds

3: Wash 15 seconds

**Table 3.** The average yield of Pb heavy metal reduction

| <b>Treatment</b> | <b>Pb content</b> |
|------------------|-------------------|
| A0               | 79.258            |
| A1               | 78.139            |
| A2               | 76.069            |
| A3               | 74.223            |
| B0               | 52.679            |
| B1               | 51.543            |
| B2               | 49.472            |
| B3               | 47.606            |

Information :

A: Fresh (unprocessed)

B: Boiled

0: Not washed (as a control)

1: Wash 5 seconds

2: Washed 10 seconds

3: Wash 15 seconds

## **b. Discussion**

Freshwater mussels contain nutrients and minerals that good for health. The abundant freshwater mussel commodities in the waters of DAM Raman, North Metro, Lampung need to be utilized. In 100 grams of freshwater mussels contains 85 grams of water, 59 calories, 8 grams of protein, 1.1 grams of fat, 3.6 grams of carbohydrates, 133 mg of calcium, 170 mg of phosphorus, 3.1 mg of iron, 300 Si vitamin A, and 0.01 mg vitamin B1 [3]. Based on that numbers, freshwater mussel is very good to be consumed to meet the body's nutritional needs. Calcium content in mussel shells is higher than beef, which is only 11 mg/100 g and chicken eggs that only 54 mg/100 g.

Accumulated lead in freshwater mussels can cause food safety problem. If the freshwater mussels are contaminated by lead, they can be the contaminant sources and cause lead accumulation inside human body. This accumulation can damage the work order of certain organs such as the nervous system, liver, and kidneys. Consuming contaminated freshwater mussel, human body will be negatively impacted, such as disorders of the nervous system, respiratory system damage, liver and kidney function, bleeding, cell growth disorders, disorders against bone growth, disruption to normal enzymatic functions, and damage to the skin [4]. Humans is the highest trophic level, so when consuming lead contaminated freshwater mussels can develop a negative impact on their health [1]. In the human body, lead is mainly bound to a group of SH-protein molecules which inhibits the enzymatic work

activity. Pb heavy metals also interfere the Hb synthesis system. The main component of Hb is hem which is synthesized from glycine and succinyl coenzyme A (CoA) using pyridoxal as a cofactor. Thus, after several steps they are bound to Fe forming a hem, which occurs in mitochondria. Hb synthesis inhibition results in anemia. The half-life of heavy metal Pb in erythrocytes is 35 days, in kidney and liver tissue for 40 days, while in bone is 30 days. Lead excretion rate through the urinary system is 76%, gastrointestinal 16%, and hair, nails, and sweat are 8%. For this reason, proper processing is needed so that the levels of Pb heavy metals found in freshwater mussel can be reduced for safe consumption.

Based on the carried out analysis the results of the lead content in control treatment of freshwater mussel (A0) is 0.080 ppm, still below the quality standard set by the National Standardization Agency (2009) which is 1.0mg / Kg or 1.0 ppm. However, this number still have to be watched out since the bioaccumulation of lead is very dangerous for the health.

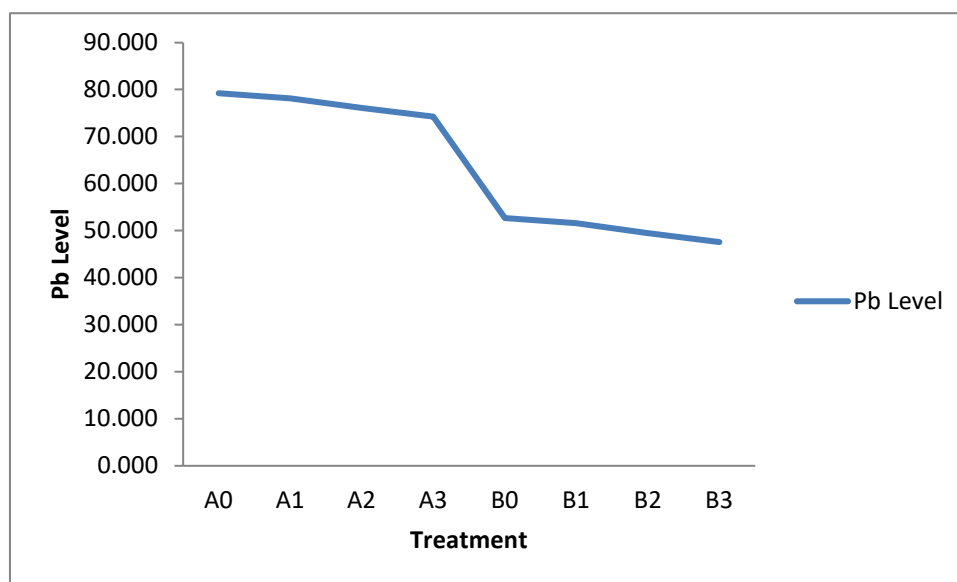


Figure 1. Graph of Decreased Pb Heavy Metals in Freshwater Mussels

Figure 1 depicts a decrease in Pb heavy metal content in the sample treated with 5 seconds, 10 seconds and 15 seconds washing. There is a decrease in Pb heavy metal content by 1% in A1, 4% in A2, and 5% in A3. From these data, it can be interpreted that the washing process can reduce the lead found on the surface of the sample. This is reinforced by research conducted that washing is effective enough to reduce the lead on the surface because it has not entered the network [5]. While the lead content within the samples treated by washing and boiling is decreased significantly. Heating process causes proteins to denature so that the complex bonds between unstable proteins and metals can be broken, which results in the metal coming out of the freshwater mussel body tissues. There are lead decreases of 34% in B0, 35% in B1, 38% in B2 and 40% in B3. Lead content within samples that have been washed and

boiled are decreased more than just washed. Overall, the most significant decrease is shown by B3, which is 40%, where the sample is washed for 15 seconds then boiled. Metal bonds between freshwater mussel and the lead are cut off due to the volatile character of this heavy metal. Therefore, using heating process can reduce the Pb metal content in freshwater mussels. Pb heavy metals which are released from metal bonds form  $Pb^+$  ions, then these ions will bind the hydroxyl ions ( $OH^-$ ), which results from ionizing heated water [6].

The most significant decrease of lead decrease is in washing treatment for 15 seconds followed by boiling for 2 minutes. ANOVA test obtains a significance value of 0,000 (smaller than the probability of 0.05), which means washing and boiling can reduce the levels of Pb heavy metals in freshwater mussel meats. In the first place, boiling for 2 minutes is chosen as treatment, because it has been standardized to cook vegetables and meat in that amount of time according to health factor. In addition, it is also able to reduce Pb content and also boiling time in two minutes will not damage the content of vitamins, proteins, and calcium in freshwater mussels. The levels of Pb heavy metals can be further decreased by longer washing and boiling, where the decrease in Pb heavy metal content decreased by 22% during 20 minutes boiling time, 50% during 25 minutes and 61.55% during 30 minutes [7].

Although food processing can reduce nutrient levels, it is still needed so that the food consumed is safe from heavy metals or other pollutants such as pathogenic microorganisms [8]. Food processing can also increase its digestibility and taste.

#### **4 Conclusion**

Based on the results of the analysis carried out, it is found that heavy metals in fresh mussel shellfish are 0.080 ppm. After washing and boiling, there is a decrease of 40%. The most significant decrease of lead decrease is in washing treatment for 15 seconds followed by boiling for 2 minutes. ANOVA test obtains a significance value of 0,000 (smaller than the probability of 0.05), which means washing and boiling can reduce the levels of Pb heavy metals in freshwater mussel meats. Based on the results of the analysis conducted, where the level of Pb heavy metals in freshwater mussel is still below the quality standard of the 2009 National Standardization Agency, freshwater mussel meat contaminated with heavy metals can be safely consumed if processed properly.

#### **5 Acknowledgment**

Director of Research and Community Service, Directorate General of Research and Development Strengthening, Kemenristek Dikti, which has provided research funding

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