Beneficial of Coriander Leaves (*Coriandrum sativum* L.) to Reduce Heavy Metals Contamination in Rod Shellfish

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Abstract. Contamination of heavy metals in certain levels of food can disrupt human health. Heavy metals have toxic properties, cannot be overhauled or destroyed by living organisms, can accumulate in the body of organisms including humans, either directly or indirectly. Heavy metals Hg, Cd, Cr is a very toxic metals (can result in death or health problems that are not recovered in a short time), while heavy metal Co, Pb, Cu toxicity is moderate (can lead to both recoverable and non-recoverable health problems in a relatively long time). Hence the heavy metal contaminating the food must be eliminated or reduced to a safe level. One effort was use coriander leaves to reduce the contamination of heavy metals in fish/shellfish. The objective of the research was to prove the extract of coriander leaves can reduce heavy metal contamination of Pb, Hg and Cu in rod shellfish (lorjuk). The treatment of this research was long soaking in coriander leaves extract that were 0, 30, 60, and 90 minutes. The results showed that the longer time of soaking can decrease Pb level from 4.4 ± 0.424 ppb to 1.7 ± 0.5 ppb, Hg level from 4.11± 0.07 to 1.12± 0.6 ppb, and Cu level from 433.7 ± 0.1 ppb to 117 ± 0.78 ppb. Protein content not significant decrease in rod shellfish (lorjuk) after 90 minutes soaking time, that was from 28.56 ± 0.403% to 26.625 ± 0.19%.

1. Introduction

Contamination of heavy metals in fish at a certain level can interfere with human health. The problem posed by heavy metals is quite complicated, because heavy metals have toxic properties, cannot be overhauled or destroyed by living things, can accumulate in the body of organisms including humans, either directly or indirectly. Heavy metals Hg, Cd, Cr, Pb are highly toxic metals (can result in death or health problems that are not recovered in a short time), medium Co coat is moderate toxicity (can cause both recoverable and non-recoverable health problems in a relatively long time). Heavy metals become toxic when they are not metabolized by the body and accumulate in tissues. Heavy metals are dangerous because they tend to accumulate in living organisms. As trace elements, some heavy metals are essential to maintain the metabolism of human body. However, at higher concentrations they can lead to poisoning. Some heavy metals like mercury, cadmium and lead are highly toxic in nature. The content of heavy metals, namely cuprum (Cu), mercury (Hg), copper (Cr), lead (Pb), and cadmium (Cd), has piled-pile settled and inundated Kenjeran Beach's water. Research conducted by “Balai Teknik...
Kesejahteraan Lingkungan” in collaboration with BPD East Java revealed that average heavy metal content in shellfish and various fish species in Kenjeran Beach area are mercury 11,35 ppb, cuprum 1,276,16 ppb, and lead 913,369. In fact, the blood samples of Kenjaran/Sukolilo people contain copper (Cu) 2511.07 ppb and mercury (Hg) 2.48 ppb. The content of Cuprum in Kenjeran area has exceeded the threshold set by the World Health Organization (WHO) and the Food and Agriculture Organization (FAO), which is 800-1200 ppb \[8\]. Therefore, efforts are needed to reduce the heavy metal components contained in various marine products in the territorial waters of Kenjeran. One way to do this is to test the ability of coriander leaves to reduce/absorb heavy metals contaminating shell fish from Kenjeran beach, Surabaya.

Some research has been done that Cilantro or better known as Coriander in Indonesia is a “biosorbent” or biomass absorbent that promises to clean heavy metals. Early in 2013, Douglas Schauer as head of the Chemical Technology program at Ivy Tech Community College in Lafayette, Indiana, led a number of students in Tula Valley near Mexico City, in search of cheap and abundant materials that can be used to filter industrial pollution waste in water soil. They tested a number of abundant wild plants, which can be dried and destroyed and one of the most effective is Cilantro\[9\]. A study of heavy metal poisoning conducted in a hospital in Japan also reported that heavy metal in the bodies of these patients decreased significantly after routine supplementation with added coriander leaves\[10\];\[11\]. Flavonoid in the coriander leaves as a chelating free radical are chaempherolan and acacetine\[12\];\[13\];\[14\]. The objectives to be achieved in this research are (1) To prove whether coriander leaves can reduce heavy metal contaminating rod shellfish obtained from Kenjeran beach; (2) evaluate the time of soaking of the contaminated rod shellfish into coriander leaf extracts to heavy metal reduction power, especially Cu, Hg and Pb.

2. Material and Method

2.1 Time and Place of Research
The research place were in Food Analysis Laboratory, Food Technology Program UPN “Veteran” East Java and LPPM Environmental Laboratory of Sepuluh November Institute of Technology Surabaya for testing heavy metal content using AAS (Atomic Absorption Spectroscopy). Duration used to complete this research for 4 months.

2.2 Materials and tools
The material used in this research was coriander leaves obtained from Ranch Market. Rod shellfish (lorjuk) was obtained from fishermen in Kenjeran, Surabaya. Materials for analysis include: CuSO\(_4\), NaOH, Folin Solutions, Aquades, Na-K Tartarics, Na\(_2\)CO\(_3\), BSA (Bovine Serum Albumin). The tools used in this research are bottles, 100 mL measuring flask, glass chemistry, porcelain cup, and Atomic Absorption Spectrophotometer (AAS).

2.3 Research methods
The research was conducted using Completely Randomized Design with single factor that was the soaking time consisting of:

- L1 = 0 minutes (control)
- L2 = 30 minutes
- L3 = 60 minutes
- L4 = 90 minutes

Each treatment was repeated 3 times.

2.4 Research Stages
a) The rod shellfish sample was taken from Kenjeran beach by and taken to the laboratory in freezing condition (using box ice)
b) Samples analysed heavy metal content including Pb, Hg and Cu.
c) Rod Shellfish was taken only without shell meat.
d) Samples soaked in coriander leaf extract smoothed with leaf ratio: water (1: 1)
e) After soaked, sample analysed the levels of heavy metals with AAS and protein content by Lowry method.

3. Result and Discussion

3.1. Content of Pb Metal in Rod Shellfish Meat
The results showed that coriander leaves extract can decrease Pb metal content in lorjuk (rod shellfish) meat from 4.4±0.424 ppb to 1.7±0.566 ppb during soaking time 90 minutes. The longer the soaking time, the Pb level decreases. In Figure 1 we can see an average decrease in Pb content in lorjuk after soaking for 0, 30, 60 and 90 minutes. One of the abundant wild plant species that can serve as a biosorbent or biomass absorber that can clean heavy metals is Cilantro or Coriander leaf [9]. This is because inside the coriander leaves contain the bioactive components of flavonoids, saponines and fibers capable of absorbing and heavy metal chelating[15]. Lead (Pb) in the blood and brain circulation can cause haemoglobin synthesis of blood disorders, neurological disorders, kidney disorders, reproductive system, acute or chronic disease of the nervous system, and impaired lung function. In addition, it can reduce IQ in young children if there is 10-20 μg/dl in the blood. Therefore Pb metal contamination in food should be eliminated.

![Figure 1. Content of Pb metals in lorjuk meat with soaking in the coriander leaves extract](image)

3.2. Content of Hg Metal in Rod Shellfish Meat
The results showed that coriander leaves extract can decrease Hg metal content in lorjuk meat, from 4.1±0.11ppb to 1.1±0.7 ppb during soaking time 90 minutes. The longer the soaking time, Hg content decreases. In Figure 2 we can see the average of Hg content in lorjuk meat after soaking for 0, 30, 60 and 90 minutes. Mercury (Hg) can accumulate and carry to other body organs, causing bronchitis, until lung damage. Symptoms of early Mercury poisoning, the patient feels his mouth is invulnerable so it is not sensitive to taste and temperature, nose is not sensitive smell, fatigue, psychological disorders (anxiety and aggressiveness), and frequent headaches. If there is a high accumulation resulted in damage to nerve cells in the cerebellum, disruption to the wide view, damage nerve sheaths and parts of the cerebellum. Derivatives by mercury (usually ethyl mercury) in the pregnancy process will appear after the baby is born which can be cerebral palsy or mental disorders, whereas acute mercury poisoning can cause damage to the digestive tract, cardiovascular disorders, acute kidney failure or shock[15].
3.3. Content of Cu Metal in Rod Shellfish Meat
The results showed that coriander leaves extract can decrease Cu content in lorjuk meat, from 433.7±0.12 ppb to 117.6±0.087 ppb during soaking time 90 minutes. The longer the soaking time, the Cu content decreases. In Figure 3 it can be seen that the average decrease in Cu content in lorjuk meat after soaking for 0, 30, 60 and 90 minutes. Coriander leaves can serve as "biosorbent" or biomass absorber which can clean heavy metals such as Cu[9]. This is because inside the coriander leaves contain the bioactive components of flavonoids, saponins and fibers capable of absorbing and heavy metal chelating[15].

3.4. Content of Protein in Rod Shellfish Meat
The results showed that coriander leaves extract did not significantly affect the decrease in protein content of lorjuk meat during 90 minute soaking. Figure 4 we can see the average protein content of lorjuk meat during the soaking time 0, 30, 60 and 90 minutes. Initial protein level of 28.56% decreased to 26.96% after soaking for 90 minutes. This result different from Nurdiani's research[16] reported that the extract of lemon can reduce heavy metal content (Pb and Cd) in freshwater fish (goldfish). The results showed that soaking for 75 minutes with a concentration of 20% extract was the most effective with a decreasing rate of up to 72.2% for carp containing Pb, while the best decrease for Cd content in carp was 15% soaking for 105 min. The weakness of the study is the decline of heavy metals contained in the body of goldfish is also followed by a decrease in protein content. Lime extract of 20% concentration with immersion 75 minutes in goldfish containing Pb metal can decrease protein content.
up to 94.4%, and 15% concentration of lime extract by soaking 105 minutes in goldfish containing Cd metal can decrease protein content until 93.2%.

From a toxicological point of view, these heavy metals can be divided into two types. The first type is an essential heavy metal, where its presence in a certain amount is needed by living organisms, but excessive amounts can have toxic effects. Examples of these heavy metals are Zn, Cu, Fe, Co, Mn and others. The second type is the unimportant or toxic heavy metal, where its presence in the body is still unknown or may even be toxic, such as Hg, Cd, Pb, Cr. Most toxicities caused by some heavy metals such as Pb, Cd, and Hg are due to its ability to close the active side of the enzymes in the cell. Heavy metals become dangerous due to the bioaccumulation system, which increases the concentration of chemical elements in living organisms[6]. Therefore, the potential of coriander leaves as a natural material that can be utilized to reduce the levels of metals in fish that are contaminated quite well because it does not affect the protein content in the fish.

4. Conclusion
Coriander leaves extract can decrease heavy metals Pb, Hg and Cu on contaminated lorjuk meat from Kenjeran Beach, Surabaya, but no significant effect on the decreases of protein content. The longer the soaking time, the higher the heavy metal contamination can be reduced from the lorjuk meat.

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