Food Safety Level on Bivalves Consumption from Kenjeran Waters Surabaya, East Java

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Abstract. Kenjeran waters are one of the waters located in the eastern part of the city Surabaya which has been polluted by heavy metals. The presence of heavy metals in the waters, automatically affect bivalves that live in these waters which will accumulate the metal on the body. This research aim was to determine the Health Benefit Value of Selenium (HBV-Se) as a food safety index from mercury contamination in bivalves consumption and to recognize MeanWeekly Intake (MWI) bivalves consumption in Kenjeran waters. The concentration analysis for Selenium using ICP-OES and Total mercury (THg) using Mercury Analyzer NIC-MA3000. Mercury and Selenium were calculated to gain HBV-Se index. The mercury concentration result showed Perna viridis 0.09 mg/kg, Siliqua patula 0.07 mg/kg, Trisidos tortuosa 0.08 mg/kg, and Anadara antiquata 0.08 mg/kg. The selenium concentration in bivalves between 0.91 mg/kg -2.49 mg/kg. The concentration of mercury below the quality standard on the limit determined by SNI, about 1 mg/kg. Total mercury from highest concentration were Perna viridis > Anadara antiquata > Siliqua patula > Trisidos tortuosa. From the calculation HBV-Se result showed positive value, it means indicating mercury contained in bivalves at Kenjeran Waters were not potentially to be toxic on the body. For the safety purpose, maximum consumption on bivalves for an adult is Perna viridis 8.64 kg/week, Siliqua patula 6.62 kg/week, Trisidos tortuosa 3.91 kg/week and Anadara antiquata 4.49 kg/week. For the same reason, the maximum consumption for children Perna viridis 1.44 kg/week, Siliqua patula 1.10 kg/week, Anadara antiquata 0.65 kg/week, Trisidos tortuosa 0.75 kg/week.

Keywords: food safety, mercury contamination, mean weekly intake, bivalve

1. Introduction
Mercury is highly toxic to human health, posing a particular threat to the development of the child in utero and early in life. It occurs naturally in axis in various form elemental (or metallic), inorganic (eg: mercury chlorid) and organic (eg: methyl and ethylmercury). These form all have to different toxicities and implication for health and for measure and prevent exposure [1]. Mercury falls from the air and can accumulate in stream and ocean and is turned into methylmercury in the water. This is the type mercury that can be harmful to your unborn baby and young child [1].

Astudillo et al measured mercury level in Perna viridis 0.02 mg/kg [1], Putri et al analysed Hg concentration in Perna viridis from Jakarta bay 0.0001 mg/kg [3]. El Nemret al (2012) [4], was reported Pattela nigolineata 0.05 mg/kg, Ostra creasta 0.03 mg/kg, Tridacna squamosa 0.01 mg/kg and Nerita peloronta 0.04 mg/kg. Selenium is an essential nutritional element, but exercise Se can be toxic to animals and humans. Selenium extremely required for activity of 25-30 genetic enzyme
(selenoenzymes). All form for life that have nervous system protect the brains for the oxidative damage. Homeostatic usually maintain optimal selenoenzyme activities. However, nutritionally relevant amount of Se can replace the Se sequestered by MeHg and maintain normal selenoenzyme activity. To recognize assessment of the relationship seafood MeHg exposure dietary Se intakes which would to serve as an index of seafood safety is HBV-Se (Health Benefit Value of Selenium). A positive HBV-Se indicates MeHg occurs in molar excess of Se, therefore consuming seafood with a HBV-Se would improve maternal and fetal Se status, whereas eating seafood with a negative HBV-Se could compromise maternal and fetal status Se (Raltson, 2015).

Mean Weekly Intake (MWI) is a acceptable level of toxic metal and can be ingested on a weekly basis, as determined the Worth Health Organization and the food[5]. The risk human healths a result of mussel consumption was evaluated by calculating the weekly metal exposure and comparing the values with respective prescribed MWI values.

2. Experimental procedures

2.1 Materials and method
Four species bivalve Perna viridis (Hijau Shell), Siliqua patula (Kijing Shell), Trisidos tortuosa (Baling Shell) and Anadara antiquata (Bulu Shell), were purchase from fisherman in Kenjeran Waters and directly placed freezer until further analysis. In laboratory, bivalve preparation was separate of mussle and shell. Morphometric analysis of weight and length of bivalve were prior for sampling preparation and sample was dried in an oven at 60°C for 24 hours. After drying, crushing was done for mussle, gills and digest sample by mortar till fine powder was obtained.

2.2 Reagent
All reagent used were of analytical reagent grang (Merck) for Hg standart solution unless otherwise started. L-Cysteine from Nacali Tesque Inc (Japan). The solution were prepared using ultrapure water (Mili-Q).

2.3 Instrumentation
The concentration analysis for Selenium using ICP-OES and total mercury (THg) using Mercury Analyzer NIC MA-3000. Morphometric analysis used calliper and analytical balance (Satorius BP 210 S). Dried sample preparation using oven (Hereus Instrument), petri dish, spatula, mortar and paste.

2.4 Total mercury and selenium measurement
Five replicates approximately 10-20 mg were weighed directly in the sample boat and analysed in mercury analyser for total mercury concentration. For Se measurement analysed used ICP-OES, we are performed five replicate in mussels, gils digest, weighing approximately 50 g with 10% HNO₃ (65% Merck, Suprapur) and heated 190°C for 30 minutes.

3. Data analysis
Total Mercury in bivalve to several standart guidelins. Mercury and selenium data in dry weight (DW) basis were convert to into wet weight (WW) by using conversion of total moisture (Raltson, 2015).

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\text{HBV-Se} = \frac{([\text{Se-Hg}] / \text{Se}) \times (\text{Se} + \text{Hg})}{\text{MWI} (\mu g/kg)} = \frac{\text{Mean Hg in fish (wet weight)} \times \left( \frac{\text{g}}{\text{g}} \right) \times \text{Weekly fish consumption (g)}}{\text{Body weight (kg)}}
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4. Result and discussion
Table 1 shows the morphometric, mercury and selenium mean concentration and standard deviation in bivalve, expressed as mg per kg of edible part (dry weight).

**Table 1.** Total mercury and selenium concentration in bivalve from Kenjeran waters

| NO | Scientific name  | Local name | n   | Weight | Length | Moisture content | THg (mg/kg DW) | TSe (mg/kg DW) |
|----|------------------|------------|-----|--------|--------|-----------------|----------------|----------------|
| 1  | *Perna viridis*  | Hijau Shell| 22  | 90-127 | 72-97  | 85.66          | 0.09±0.03      | 1.56±0.5       |
|    | *Siliqua patula* | Kijing Shell| 11  | 137    | 33-44  | 78.56          | 0.07±0.004     | 1.47±0.16      |
| 3  | *Trisidos tortusa* | Baling Shell | 29  | 73-96  | 31.2   | 64.14          | 0.06±0.004     | 3.4±0.15       |
| 4  | *Anadara antiquata* | Bulu Shell | 15  | 31-55  | 55.8   | 63.49          | 0.08±0.007     | 2.49±0.31      |

The mercury concentration on Kenjeran water is not very variation, concentration average is 0.04 mg/kg (*Pinna muricata*)-0.09 mg/kg (*Perna viridis*). All the value mercury concentration below the quality standard on the limit determination buy SNI about 1 mg/kg. Total mercury value from the lowest were *Trisidos tortuosa*<*Siliqua patula*<*Anadara antiquata*<*Perna viridis*. The earlier studies, described mercury concentration in bivalve from kenjeran was 0.2 mg/kg, it value not much different with my studied. The guideline of SNI about 1 mg/kg, it means bivalve in Kenjeran can be consume.

The selenium concentration on Kenjeran waters varies from 0.91 mg/kg in *Pinna muricata* to 3.4 mg/kg in *Trisidos tortuosa*. The red line on figure is SNI reference standard for mercury. Selenium is a nutrionally essential trace element. Selenium very important function in brain. Mercury a oxidative damage, but is not due to direct mechanism (Raltson, 2015). Instead, their effect to inhibition of the
selenoenzym activities the prevent and reserve oxidative damage arising from free radical and reactive oxygen species formed during normal oxygen metabolism. The selenium in bivalve from Kenjeran has a selenium over compared with mercury, it mean bivalve in Kenjeran considered safety for consumed.

All HBV-Se showed positive value. It mean, a positive HBV-Se value indicated occurs in molar excess MeHg in the bivalve. The value to showed Se surplus or deficit mercury in a bivalve. It mean, bivalve in Kenjeran water safety for consumption.

Table 2 shows Mean Weekly Intake (MWI) value for adult and toddler and than shows minimal and maximum value for Mean Weekly Intake (MWI) in bivalve.

**Figure 2.** HBV-Se index from Kenjeran Waters

All HBV-Se showed positive value. It mean, a positive HBV-Se value indicated occurs in molar excess MeHg in the bivalve. The value to showed Se surplus or deficit mercury in a bivalve. It mean, bivalve in Kenjeran water safety for consumption.

**Tabel 2.** Mean Weekly Intake (MWI) in bivalve from Kenjeran waters

| No | Scientific name | Local name | MWI | Adult (60 kg) (kg/week) | Min (kg/week) | Max (kg/week) | Toddler (10 kg) (kg/week) | Min (kg/week) | Max (kg/week) |
|----|-----------------|------------|-----|-------------------------|---------------|---------------|--------------------------|---------------|---------------|
| 1  | *Perna viridis* | Hijau Shell |     | 8.35                    | 7.85          | 8.64          | 1.38                     | 1.31          | 1.44          |
| 2  | *Siliqua patula*| Kijing Shell |     | 6.02                    | 5.56          | 6.02          | 1                        | 0.93          | 1.1           |
| 3  | *Trisidos tortuosa* | Baling Shell | | 4.15                    | 3.7           | 4.49          | 0.69                     | 0.62          | 0.75          |
| 4  | *Anadara antiquata* | Bulu Shell |   | 3.29                    | 3.13          | 3.91          | 0.55                     | 0.52          | 0.65          |

Mean Weekly Intake (MWI) has a two criteria, that is adult (60kg) and toddler (10 kg). For adult, the safety consumption, we can consume between 7.85 kg/week to 8.64 for *Perna viridis*, 5.56 kg/week to 6.02 for *Siliqua patula*, 3.7 kg/week to 4.49 kg/week for *Trisidos tortuosa* and for *Anadara antiquata* 3.13 kg/week to 3.91. For toddler, 1.31 kg/week to 1.44 kg/week for *Perna viridis*, 0.93
kg/week to 1.1 kg/week for Silicia patula, 0.62 kg/week to 0.75 kg/week for Trisidos tortuosa and 0.52 kg/week to 0.65 kg/week for Anadara antiquata.

5. Conclusion
The mercury concentration in bivalve from Kenjeran has below the quality standard on the limit determined by SNI. The HBV-Se to reveal the Se surplus and the deficit for mercury in a bivalve. According to Mean Weekly Intake (MWI), Perna viridis is a highest consumption bivalve for adult and toddler from Kenjeran water.

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