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Konsentrasi Kadmium dan Kromium pada Kerang Hijau (*Perna viridis*) dan Sedimen di Pesisir Grinting, Brebes

Concentration Cadmium and Chromium in Green Mussels (Perna viridis) and Sediment on Grinting Coast, Brebes

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ABSTRAK

Kadmium dan kromium merupakan logam berat yang sulit terdegradasi dan dapat terakumulasi di perairan, terutama pada kerang hijau dan sedimen. Penelitian ini bertujuan untuk mengetahui kandungan logam berat kadmium (Cd) dan kromium (Cr) pada kerang hijau (*Perna viridis*) dan sedimen, serta untuk mengetahui tingkat kelayakan konsumsi kerang hijau dari sudut pandang kemanan pangan. Pengambilan sampel dilakukan pada bulan Juni 2022 di Pesisir Grinting, Kabupaten Brebes. Metode penelitian menggunakan metode deskriptif dengan pengambilan sampel dilakukan secara *purposive sampling*. Konsentrasi logam Cd dan Cr dianalisis menggunakan metode AAS. Hasil penelitian menunjukkan bahwa konsentrasi logam Cd dan Cr pada kerang hijau berada di bawah ambang batas sebesar 0,18 $mg.kg^{-1}$ dan 0,12 $mg.kg^{-1}$. Pada sedimen, kandungan Cd sebesar 46,61 $mg.kg^{-1}$ yang mana melebihi baku mutu sedangkan untuk kandungan Cr masih dibawah ambang batas yaitu sebesar 0,10 $mg.kg^{-1}$. Batas maksimum konsumsi kerang hijau yang dapat ditoleransi dalam kg/minggu ditinjau dari konsentrasi Cd dan Cr bagi laki-laki sebesar 2,333 kg/minggu dan 11,650 kg/minggu. Sedangkan untuk wanita sebesar 1,750 kg/minggu dan 8,738 kg/minggu. Dari segi keamanan pangan, nilai EDI (*Estimate Daily Intake*) berdasarkan konsentrasi logam berat Cd dan Cr berturut-turut adalah 0,108 dan 0,072 $\mu g.kg^{-1}$ dan nilai THQ (*Target Hazard Quotient*) Cd dan Cr sebesar 0,108 dan 0,048 $\mu g.kg^{-1}$. Nilai EDI dan THQ ini menunjukkan risiko rendah terhadap kesehatan manusia dan kerang hijau memenuhi standar keamanan pangan.

Kata kunci: *Kadmium, Kromium, Kerang hijau*

ABSTRACT

Cadmium and chromium are heavy metals that are difficult to degrade and can accumulate in waters, especially in green mussels and sediments. This study aims to determine the heavy metal content of cadmium (Cd) and chromium (Cr) in green mussels (Perna viridis) and sedimen, and to determine the feasibility of green mussels for consumption in the perspective of food safety. Sampling was carried out in June 2022 on the Grinting Coast, Brebes Regency. The research method uses a descriptive method with sampling carried out

by purposive sampling. The metal concentrations of Cd and Cr were analyzed using the AAS method. The results showed that the concentration of Cd and Cr metals in green mussels were below the threshold at 0.18 $mg.kg^{-1}$ and 0.12 $mg.kg^{-1}$. In sediments, the content of Cd is 46.61 $mg.kg^{-1}$ which exceeds the quality standard while the content of Cr is still below the threshold of 0.10 $mg.kg^{-1}$. The maximum tolerable intake of consumption of green mussels in kg/week in terms of Cd and Cr concentrations for men is 2.333 kg/week and 11.650 kg/week. As for women it is 1.750 kg/week and 8.738 kg/week. In terms of food safety, the EDI (Estimated Daily Intake) value based on the result of heacy metals Cd and Cr concentration was 0.108 and 0.072 $\mu g.kg^{-1}$ and THQ (Target Hazard Quotient) values for Cd and Cr was 0.108 and 0.048 $\mu g.kg^{-1}$. These value of EDI and THQ indicate low risk to human health and the green mussels are meet food safety standards.
Keywords: *Cadmium, Chromium, Green Mussels*

INTRODUCTION

Grinting Coast is one of the water areas located in Bulakamba District, Brebes Regency, Central Java (Wahyu *et al*., 2022) which has characteristics as a mangrove ecosystem area and is also an active green mussel cultivation area with a substrate in the form of mud and clay (Gemilang *et al*., 2018). The coastal area of Grinting is also widely used as agricultural and livestock land, and there are many industries around it, both small industries and large industries (Toharudin *et al*., 2020). The influence of this geographical location causes the Grinting coast to have the potential to become a place for accumulation of organic or inorganic matter that is transported into it such as heavy metals (Ismanto *et al.*, 2019).

Harmful heavy metals that pollute marine waters are cadmium (Cd) and chromium (Cr). Both of these heavy metals are toxic and harmful metals if they accumulate in the body of the organism at high concentrations (Nuraini *et al*., 2017) as well as over a long period of time (Purba *et al*., 2014). The use of cadmium and chromium metals in industry is very much, ranging from the textile industry to the metal industry, so it is possible that these metals can enter the waters through natural sources and from activities carried out by humans (Adhani & Husaini, 2017). Pollutants that enter the waters will be scattered and will undergo a settling process, resulting in the spread of pollutants (Murraya *et al*., 2015). The process of deposition of heavy metals scattered in the waters will accumulate in sediments and then will accumulate in the biota in it, one of which is green mussels. Green mussels (*Perna viridis*) are one type of shellfish that live at the bottom of the waters and are a type of shellfish that is much loved by the community.

Grinting Coast is one of the potential places for green mussel cultivation. Given the nature of the green mussel filter feeder in obtaining food and can accumulate heavy metal pollutants in the waters. Therefore, this study aims to examine the content of heavy metals Cd and Cr in sediments and green mussels (*Perna viridis*) and to determine the maximum weekly consumption limit and feasibility level of consumption of green mussels containing heavy metals Cd and Cr in Grinting Coast, Brebes Regency.

METHODS

Sample Collection

The study was conducted in June-July 2022 on the Grinting Coast, Bulakamba District, Brebes Regency. The material used in this study was samples of seawater, sediment, and green mussels (*Perna viridis*). Then, the environmental

Figure 1. Research Location in Coastal Grinting, Bulakamba District, Brebes Regency

parameters such as temperature, pH, TDS, conductivity, salinity, DO, and BOD were measured during sampling. The method used is a descriptive method with purposive sampling. Analysis of heavy metal content in green mussels and sediments, as well as water quality analysis were carried out at the Productivity and Aquatic Environment Laboratory (ProLing) of Bogor Agricultural University.

Water Quality Analysis

Water quality was analyzed based on APHA 23rd Edition (2017) namely the AAS method. 250 mL of filtered and preserved water samples were put into a polyethylene separatory funnel, then were extracted with 2.5 mL of ammonium pyrrolidine dithiocarbamate (APDC) and 25 mL of methyl isobutyl ketone (MIBK). Next, it was homogenized for 5 minutes, then allowed to stand until the two phases separated. After the phase is separated into 2 parts, the water phase was discharged while the organic phase was used for the manufacture of standard solutions. The organic phase was re-extracted with HNO_3, then the extraction results were analyzed using AAS.

Heavy Metal Analysis in Green Mussels (*Perna viridis*) and Sediment

Heavy metal content in green mussels was analyzed based on APHA 23rd Edition (2017). A total of 2-5 grams of mashed green mussel meat was put into a cup and heated in a 200°C hot plate for 2 hours until it is charcoal-shaped. The sample was put into a 550°C furnace for 8 hours until it turned ash. Next, the samples were cooled in a desiccator. Then aquades and 2 mL HNO_3 were added. The sample was then put into a 50 mL measuring flask and aquades was added to the boundary mark. Furthermore, the sample was filtered with Whatman 40 paper into a sample bottle and the sample was analyzed using AAS to determine the metal levels of Cd and Cr in it.

Heavy metal content in sediments was analyzed based on APHA 23rd Edition (2017). Sediment samples were dried in the oven at 105°C for 3 hours, then mashed. 5 grams of mashed sediment was put into the boiling flask, then 10 mL of HNO_3 was added and digested for 3 hours at 120°C. The result of the digestion were cooled and filtered with whatman 40 paper and the filtrate

was collected in a 100 mL measuring flask and diluted with aquades up to the mark. The filtrate was then analyzed using AAS (Atomic Absorption Spectrophotometer).

The results of the analysis of heavy metal Cd in green mussels were compared with quality standards according to the National Standardization Agency (BSN) in 2009 and ANZECC/ARMCANZ in 2000 from Australia and New Zealand for the heavy metal content of Cd in sediments. The results of the analysis of heavy metal Cr in green mussels were compared with quality standards according to FAO (Food and Agriculture Organization) in 2016, while for Cr content in sediments based on NOAA (National Oceanic and Atmospheric Administration) in 1999. Water quality analysis data on the Grinting coast were compared to quality standards according to PP RI No. 22 of 2021, PP RI No. 82 of 2001, and the appropriate references.

Maximum Tolerable Intake (MTI)

Green mussels are a type of mussel that is often consumed by the community. The safety level value or safe limit for consumption is used as a reference to avoid the adverse effects that heavy metals can cause if they enter the body (Irawati *et al.,* 2018). The safe limit for consuming green mussels that already contain heavy metals in this study was calculated using the provisional tolerable weekly intake (PTWI) with reference to WHO and JEFCA in Clara *et al.*, (2022) for the heavy metal Cd and for the heavy metal Cr referring to WHO and JEFCA in Nuraini *et al.,* (2017). The maximum weekly intake according to Zazouli *et al.*, (2006) was calculated using the following formula:

Maximum Weekly Intake (mg/kg) = Weight x PTWI

Information:

- Weight: For assuming an average male weight of 60 kg and an average female body weight of 45 kg per week
- PTWI (Provisional Tolerable Weekly Intake): Maximum limit tolerance rate per week (cadmium heavy metal of 0.007 µg/kg body weight per week and chromium heavy metal of 23.3 µg/kg body weight per week)

The maximum tolerable intake (MTI) value was calculated by the following formula (Turkmen *et al.*, 2008):

MTI = MWI/Ct

Information:

- MWI : Maximum Weekly Intake (µg assuming average male weight 60 kg and average female weight 45 kg/week)
- Ct : Heavy metal concentration in green mussels (µg/g)

Estimated Daily Intake (EDI)

Estimated Daily Intake (EDI) is an estimate of heavy metal intake that enters the human body through daily food consumption. The EDI value is based on the level of consumption (g/day) of fishery products and the concentration of contamination in foodstuffs. This value varies depending on human weight (Purbonegoro, 2020). The EDI value can be calculated using the aquation according to Hidayati *et al*. (2022):

$$EDI = \frac{C \ x \ Cons}{body \ weight}$$

Information:

C : Concentration of heavy metals in mussels (mg/kg)

Cons : Total mussles consumption/person/day (g)

Body weight : Average body weight of an adult (kg)

Target Hazard Quotients (THQ)

The Target Hazard Quotient (THQ) is the ratio of potential exposure to a substance where no adverse effects occur (Satriawan *et al*., 2021). The THQ value is

useful in assessing human health risks to metals contained in polluted biota (Yap *et al*., 2016). THQ value can be calculated using the aquation according to Hidayati *et al*. (2022):

$$THQ = EDI/RfD$$

Information:
EDI: Estimated Daily Intake (µg/kg)
RfD: Daily maximum estimated value (µg/kg)

RESULTS AND DISCUSSIONS

The results of this research included water quality parameters on the Grinting Coast, the heavy metal content of Chromium (Cr) and Cadmium (Cd) in green mussels (*Perna viridis*) and sediment, and the calculation of the maximum tolerable intake of green mussels contaminated with heavy metals.

Water Quality on The Grinting Coast

The results of water quality measurements on the Grinting Coast, Bulakamba District, Brebes Regency taken in June 2022 are presented in **Table 1**.Based on measurements of water quality on the Grinting Coast area in **Table 1**, it shows varying values for each parameter and is still classified as safe for green mussel cultivation activities when viewed from several parameters that still meet quality standards such as for example temperature. The temperature on the Grinting Coast has a value of 28.65°C and includes the optimal temperature for the growth of green mussels. This is in accordance with the opinion according to Sulvina *et al*., (2015) that the optimum temperature for green mussels ranges from 26-32°C. While other opinions state that if the temperature is too high it will cause the green mussels to die, increasing the accumulation and toxicity of heavy metals (Sukoasih & Widiyanto, 2017). The highest temperature that green mussels can tolerate is 37°C, however it poses a high risk of the organism dying (Zahroh *et al.,* 2019).

Concentration of Cadmium and Chromium Heavy Metals in Green Mussel (*Perna viridis*) and Sediment

Heavy metal concentrations in green mussels (*Perna viridis*) and sediments on the Grinting Coast, Bulakamba District, Brebes Regency are presented in **Table 2**.

Table 1. Water Quality on The Grinting Coast, Bulakamba District, Brebes Regency

Parameter	Unit	Value	Quality Standards
Temperature	°C	28.65	28-30 °C [(1)]
TSS	mgL $^{-1}$	<8**	20-80 mgL $^{-1}$ [(1)]
TDS	mgL $^{-1}$	2895*	1,000 mgL $^{-1}$ [(2)]
Conductivity	Sm $^{-1}$	43.45**	45-55 Sm $^{-1}$ [(4)]
DO	mgL $^{-1}$	7.4	>5 mgL $^{-1}$ [(1)]
Salinity	‰	27,4	18-33‰ [(3)]
Ph	-	8.345	7-8.5 [(1)]
COD	mgL $^{-1}$	27.42**	<25 mgL $^{-1}$ [(2)]
BOD	mgL $^{-1}$	29*	20 mgL $^{-1}$ [(1)]

Information:
*: Exceeding quality standards
**: Less than the quality standard
[1] : PP RI No. 22 of 2021
[2] : PP RI No. 82 of 2001
[3] : FIGIS (2005)
[4] : Sahwilaksa (2014)

Table 2. Heavy Metal Concentrations (Cr, Cd) in Green Mussels (Perna viridis) and Sediments on The Grinting Coast Bulakamba District, Brebes Regency

Heavy Metals	Sample	Consentration (mg/kg)	Quality Standards (mg/kg)
Cadmium (Cd)	Green Mussels	0.18	1.00[(5)]
	Sediment	46.61	1.5[(6)]
Chromium (Cr)	Green Mussels	0.12	1.00[(7)]
	Sediment	0.10	52.3[(8)]

Information:

5 : *Badan Standarisasi Nasional* (BSN) (2009)

6 : ANZECC/ARMCANZ *Sediment Quality Guidelines* (2000)

7 : FAO (Food and Agriculture Organization) (2004)

8 : National Oceanic and Atmospheric Administration (NOAA) (1999)

Based on data on the concentration of heavy metals cadmium and chromium in green mussels on the Grinting Coast presented in **Table 2**, both of them show values below the established quality standards where green mussels contain a concentration of cadmium heavy metal of 0.18 $mgKg^{-1}$ and chromium heavy metal of 0.12 $mgKg^{-1}$. This shows that the green mussel samples studied are still suitable for consumption. The low concentration of these heavy metals can be caused by high rainfall. This is in line with the statement from Noviansyah *et al*., (2021) that the low heavy metal content is thought to be due to a dilution process caused by rainfall which results in a decrease in salinity. Although the concentration of heavy metals in green mussels is still relatively low, consumption must be in accordance with the maximum consumption limit because if consumed in the long term it will still have a negative impact on humans. Considering that green mussels are sessile organisms and filter feeders, they have a very large possibility of heavy metal accumulation (Krismonita *et al*., 2023). Another opinion, according to Pratiwi (2020), states that the negative impact of heavy metal accumulation on the human body is a disruption in lung physiology.

The results of the analysis of the heavy metal content of cadmium (Cd) and chromium (Cr) in the sediments on the Grinting Coast are presented in **Table 2**, showing values of 46.61 $mgKg^{-1}$ and 0.10 $mgKg^{-1}$. This shows that the sediment samples containing Cadmium (Cd) metal that has exceeded the quality standard set by ANZECC/ARMCANZ (2000), which is 1.5 $mgKg^{-1}$. It is different from the content of heavy metal chromium (Cr) was still below the quality standards set by National Oceanic and Atmospheric Administration (NOAA) (1999) of 52.3 $mgKg^{-1}$. Although each heavy metal content varies, sediment is an environmental parameter that affects the abundance of macrozoobenthos, one of which is green mussel, because heavy metals can precipitate, accumulate in sediments and be absorbed by marine organisms. Meanwhile, the heavy metal concentration of cadmium showed a much higher value when compared to the heavy metal content in green mussels. This can be caused by the accumulation of heavy metals that precipitate in sediments. This opinion is reinforced by statements from Begum *et al.*, (2009) that heavy metals can interact with organic matter in the soluble phase and then precipitate, causing high concentrations in sediments. Another opinion from Natsir *et al*., (2021) said that sediment is a potential place for accumulation of heavy metals in the marine environment.

Calculation of Maximum Tolerable Intake (MTI)

The calculation results of the Maximum Tolerable Intake (MTI) of green mussels contaminated with heavy metals cadmium (Cd) and chromium (Cr) can be seen in **Table 3**.

Information:

[5] : WHO dan JEFCA *in* Clara *et al.*, (2022)

[6] : WHO dan JEFCA *in* Nuraini *et al.*, (2017)

Information in **Table 3**. shows the calculation of the maximum weekly intake and the maximum tolerable intake. The weekly maximum consumption limit of green mussels contaminated with the heavy metal cadmium (Cd) on the Grinting Coast, Bulakamba District, Brebes Regency can be seen in **Table** 3, where the MWI (Maximum Weekly Intake) is calculated by multiplying the value of the Provisional Tolerable Weekly Intake (PTWI) or the maximum tolerance limit per week issued by *The World Health Organization* (WHO) for the heavy metal cadmium (Cd) is 7 µg/kg assuming the body weight used for men is 60 kg and for women with an average body weight of 45 kg. After calculating, the MWI value of the heavy metal Cd for men is 0.420 mg/week, while for women it is 0.315 mg/week. According to FAO/WHO through JECFA the normal tolerance limit for Cd intake in the human body is 400-500 µg or 0.4 mg per week per 60 kg body weight or not more than 60 µg/day (Marwah *et al.*, 2015).

After calculating the MWI value, MTI (Maximum Tolerable Intake) is then calculated by dividing the MWI value by the concentration of the heavy metal cadmium (Cd) in the green mussel sample. MTI needs to be calculated in order to know the maximum value of consumption of foodstuffs contaminated with heavy metals per week. So that the MTI value for men weighing 60 kg is 2.333 kg/week, and for women weighing 45 kg is 1.750 kg/week. Someone is advised to consume below the safe limit of consuming food contaminated with the heavy metal cadmium (Cd) in order to minimize and even avoid the chronic effects that can be caused. According to Palar (2004) *in* Marwah *et al.*, (2015), chronic effects due to cadmium (Cd) toxicity in humans include damage to the kidneys, respiratory organs, reproductive system and bone fragility.

The weekly maximum consumption of green mussels contaminated with the heavy metal chromium (Cr) on the Grinting Coast, Bulakamba District, Brebes Regency has been calculated by setting the Maximum Tolerable Intake (MTI) per week for the assumption that the average body weight used for men is 60 kg and for women with an average body weight of 45 kg. Before setting the MTI value of green mussels, the weekly maximum consumption of heavy metals is calculated first by setting the Maximum Weekly Intake (MWI). MWI is calculated by multiplying the Provisional Tolerable Weekly Intake (PTWI) value or the maximum tolerance limit per week issued by *the World Health Organization* (WHO) for the heavy metal chromium (Cr) of 23.3 µg/kg assuming the body weight used in

Table 3. *Calculation of Maximum Tolerable Intake (MTI)*

Heavy Metals	Gender	Body Weight (kg)	*Provisional Tolerable Weekly Intake*/PTWI (µg/kg/week)	*Maximum Weekly Intake*/MWI (mg/week)	*Maximum Tolerable Intake*/MTI (kg/week)
Cadmium (Cd)	Man	60	7[(9)]	0.420	2.333
	Woman	45	7[(9)]	0.315	1.750
Chromium (Cr)	Man	60	23.3[(10)]	1.398	11,65
	Woman	45	23.3[(10)]	1.049	8,738

Table 3. The MWI value of the heavy metal chromium (Cr) for men with an average body weight of 60 kg is 1.398 mg/week. Meanwhile, the MWI value for women with an average weight of 45 kg is 1.049 mg/week. If the Cr concentration exceeds the MWI value, it will cause poisoning. This is in line with Kurniawati *et al*., (2021) that the accumulation of the heavy metal chromium (Cr) can cause various problems including damage to respiratory organs such as asthma, kidney and lung cancer.

Maximum Tolerable Intake value for mussels on the Grinting Coast, Bulakamba District, Brebes Regency for males is 11.65 kg/week while females are 8.738 kg/week. The higher the MTI value, the smaller the concentration of the heavy metal chromium (Cr) in green mussels. This is evidenced by references according to Azhar *et al*., (2012) showing the content of heavy metal chromium (Cr) in Wedung Waters touching 0.7 mg/kg and the MTI value is only 5.76 kg/week assuming a body weight of 60 kg. Then it is also reinforced by references from Nuraini *et al*., (2017) showing that the content of the heavy metal chromium (Cr) in the Grinting Coast only reaches 0.11 mg/kg and the MTI gain reaches 17.68 kg/week assuming a body weight of 60 kg. Based on the MTI value obtained, a person may only consume green mussels at a predetermined value so that their health is not disturbed due to the influence of the heavy metal chromium (Cr). If someone consumes green mussels from the Grinting Coastal area, exceeding the estimated MTI limit in Table 3, it can cause negative health effects such as respiratory tract, skin, blood vessel, and kidney disorders (Sudarmaji *et al.*, 2006).

Estimated Daily Intake (EDI)

Estimated Daily Intake (EDI) is an estimation of heavy metal intake that enters the human body through daily food consumption (Purbonegoro, 2020). The EDI assessment aims to assess warnings of adverse health effects caused by a type of heavy metal (Rayyan *et al.,* 2019). The Estimated Daily Intake (EDI) calculation results for green mussels contaminated with heavy metals cadmium (Cd) and chromium (Cr) at the Grinting coast can be seen in **Table 4**.

Based on **Table 4**. It is known that the EDI values in green mussels contaminated with Cd and Cr metals are 0.108 and 0.072 µg/kg. These results show that the EDI value obtained is below the RfD standard for Cd metal, which is 1 µg/kg. Similarly, for Cr metal, the EDI value obtained is still below the RfD Cr standard, which is 3 µg / kg (Yap *et al*., 2016). If the EDI value of heavy metals ≤ RfD, then the health risk will be minimum and if the EDI value > 1-5 times the RfD of the heavy metal tested then the risk is low. Another case if EDI > 5-10 times RfD then the risk is moderate and if EDI > 10 times RfD then the potential risk is high (Javed & Usmani, 2016). Thus, judging from the calculation results that show the EDI value of Cd and Cr < RfD metals, it can be categorized as a minimum health risk. This means that people who consume green mussels contaminated with heavy metals Cd and Cr on the Grinting coast are not

Table 4. *EDI Value of Green Mussels on the Grinting Coast, Brebes*

Heavy Metals	Concentration (mg/kg)	EDI (µg/kg)
Cadmium (Cd)	0,18	0,108
Chromium (Cr)	0,12	0,072

potentially at risk of ill health. However, if consumed in excess it will potentially affect human health.

Target Hazard Quotient (THQ)

Target Hazard Quotient (THQ) is an index used in the assessment of human health risks to metals (Yap *et al*., 2016), The results of the calculation of Target Hazard Quotient (THQ) in green mussels contaminated with cadmium (Cd) and chromium (Cr) heavy metals on the Grinting coast can be seen in **Table 5**.

Table 5*. THQ Value of Green Mussels on the Grinting Coast, Brebes*

Heavy Metals	Concentration (mg/kg)	THQ	RfD (µg/kg)
Cadmium (Cd)	0,18	0,108	1
Chromium (Cr)	0,12	0,048	3

Based on ***Table 5***. it can be seen that the THQ values of green mussels contaminated with Cd and Cr metals were 0.108 and 0.048 µg/kg. These results indicate that the THQ value obtained is less than 1, which means there is no risk of contaminants in the food. This is in accordance with the statement of Yap *et al*. (2016), if the THQ value is ≤ 1, it can be said that there is no risk of contamination content in food ingredients. Meanwhile, if the acquisition value of THQ > 1 then there is a risk arising from the presence of contaminants in the food. Thus, green mussels in the Grinting Coast are still suitable for consumption because they do not pose a bad risk to the health of humans who consume them. In accordance with the statement of Palgunadi & Purnama (2022) that a THQ value <1 indicates a non-carcinogenic health risk that can arise from consuming green mussels which is low. This is because the respondents are classified as adults so they are able to tolerate heavy metals that enter their bodies, in which these heavy metals will be excreted from the body through the urinary tract and digestive organs so that they are not further spread throughout the body by blood.

]CONCLUSIONS

The concentration of heavy metals cadmium (Cd) and chromium (Cr) in green mussels which are still below the established quality standards. Meanwhile, the concentration of heavy metal cadmium (Cd) in the sediment which exceeded the quality standard and concentration of chromium (Cr) in sediments which is still below the quality standards. The maximum weight of green mussel intake that is safe for consumption in terms of the concentration of cadmium (Cd) heavy metal from coastal grinting for men with a body weight of 60 kg is 0.0023 kg/week and for women with a body weight of 45 kg is 0.0018 kg/week. The maximum limit of green mussel intake that is safe for consumption in terms of the concentration of heavy metal chromium (Cr) from coastal Grinting for men with a body weight of 60 kg is 11.65 kg/week and for women with a body weight of 45 kg is 8.738 kg/week. The standard of feasibility consumption for human's based on the value of EDI and THQ on heavy metals Cd and Cr of green mussels in coastal Grinting is classified safe or low risk to human's health.

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