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RESEARCH ARTICLE **ARAŞTIRMA MAKALESİ**

Heavy metals concentration in mud crab (*Scylla serrata*) and related soil at Chattogram and Cox's Bazar area of Bangladesh

Bangladeş'in Chattogram ve Cox's Bazar bölgesindeki çamur yengeci (*Scylla serrata*) ve ortam çamurundaki ağır metal konsantrasyonu

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Abstract: Heavy metal levels have increased due to increased industrialization, which has a negative impact on crab, an essential source of protein. This study aimed to measure the level of certain heavy metals (Pb, Cd, and Hg) in edible tissue from mud crab (*Scylla serrata*) and related soil collected from Chattogram and Cox's Bazar in Bangladesh. The concentration of heavy metals in mud crab and the soil were determined using an Atomic Absorption Spectrophotometer (AAS) (Model ICE 3300). While the mean values of heavy metals in crab tissue samples from Chattogram were 0.06 mg/kg for Cd and 0.45 mg/kg for Pb, in the related soil samples these values were determined as 0.52 mg/kg for Cd and 7.24 mg/kg for Pb. In Cox's Bazar, the mean Pb content was 4.1 mg/kg in related soil, but the levels of Cd and Hg were below the detection limit. In *S. serrata* tissues, all heavy metal concentrations were below the detection limit. The heavy metal values obtained in the study were compared with the Food and Agriculture Organization (FAO), World Health Organization (WHO), European Union (EU) and Food and Drug Administration (FDA). Results concluded that metal concentrations were within permissible limits and did not pose an immediate risk to public health or human consumption. Specifically, the measured concentration levels are considered poor when compared to national and international requirements.

Keywords: Metal pollution, coastal area, concentration, *Scylla serrata*

Öz: Sanayileşmenin artması nedeniyle ağır metal seviyeleri artmakta ve bu da önemli bir protein kaynağı olan yengeç üzerinde olumsuz etki yaratmaktadır. Bu çalışma, Bangladeş'teki Chattogram ve Cox's Bazar'dan toplanan çamur yengecinin (*Scylla serrata*) yenilebilir dokusunda ve ilgili çamurda bazı ağır metallerin (Pb, Cd ve Hg) düzeyini ölçmeyi amaçlamıştır. Yengeç ve çamurdaki ağır metallerin konsantrasyonu, Atomik Absorbsiyon Spektrofotometresi (AAS) (Model ICE 3300) kullanılarak belirlenmiştir. Chattogram'dan alınan yengeç doku örneklerinde ağır metallerin ortalama değerleri Cd için 0,06 mg/kg ve Pb için 0,45 mg/kg iken ilgili çamur örneklerinde bu değerler Cd için 0,52 mg/kg ve 7,24 mg/kg olarak saptandı. Cox's Bazar'da ilgili toprakta ortalama Pb içeriği 4,1 mg/kg iken Cd ve Hg düzeyi tespit sınırının altındaydı. *S. serrata* dokularında ise tüm ağır metal konsantrasyonları tespit sınırının altındaydı. Çalışmada elde edilen ağır metal değerleri Gıda ve Tarım Örgütü (FAO), Dünya Sağlık Örgütü (WHO), Avrupa Birliği (AB) ve Gıda ve İlaç İdaresi (FDA) ile karşılaştırılmıştır. Sonuçlar, metal konsantrasyonlarının izin verilen sınırlar dahilinde olduğu ve halk sağlığı veya insan tüketimi açısından acil bir risk oluşturmadığı sonucuna varmıştır. Spesifik olarak ölçülen konsantrasyon seviyeleri, ulusal ve uluslararası gerekliliklerle karşılaştırıldığında zayıf kabul edilmektedir.

Anahtar kelimeler: Metal kirliliği, kıyısal alan, konsantrasyon, *Scylla serrata*

INTRODUCTION

Pollution of marine environments is a persistent worldwide issue. The issue of aquatic environment contamination by trace metals is drawing international attention, especially in developing nations such as Bangladesh (Ahmed et al., 2015). The main human-caused sources of heavy metal contamination of water, sediment, and aquatic life include industrial activities, mining, and the disposal of toxic, partially treated effluents containing metals. Trace metals are common and may accumulate in the environment, in fish, crustaceans, water, and sediments. They can then make their way up the food chain to humans. As a typical benthic organism, crustaceans particularly crabs may be regarded as a completely distinct aquatic species (Ololade et al., 2011). They may also serve as useful indicators of the levels of pollution in surface debris. Depending on the environmental conditions of the waters, heavy metal pollution that enters the aquatic ecosystem will dissolve in the water, collect in sediments, and may even get worse with time. Through the food chain, heavy metals can pass from one creature to another as well as from the environment to living things (Sugiarti et al., 2016). Some contaminants that pose a threat to aquatic biota include non-essential metals including Pb, Cd, and Hg (Setiawan, 2013). Crabs *Scylla serrata* are commonly found in mangrove zone, estuarine area, and coastal regions. Because of their increased ingesting, crabs are becoming more and more important, and this has made biological studies of them important (Sangun et al., 2009). Bangladesh's coastal regions are home to a variety of river mouth types, which contribute to the development of an estuary ecology close to the coastline (Kamal and Khan, 2009). Due to their reputation as deposit feeders in aquatic environments, mud crabs have the ability to collect heavy metals (Suprapti et al., 2012). Bangladesh's second-biggest metropolis and industrial hub is Chattogram. The banks of the Karnafuly river system are home to thousands of companies and industries. Bhatiary, Salimpur, Barabkunda, Kumira, and Sitakunda are important shipbuilding locations. They are situated on the Karnafully River's bank and along the Bay of Bengal shore. The Karnafully River and other bodies of water are contaminated by shipbreaking firms' releases of dangerous metal, persistent organic and inorganic contaminants, untreated solid waste, and liquid effluent. The shipbreaking industry is one of the major sources of trace metal on the Chattogram coast. This shipbreaking pollutes the air, sea, land, and vegetation (Das et al., 2002). There are about 30 shipbreaking yard in Bhatiary-Sonaichari shipbreaking area. Heavy metal found in different part of ship such as painting, coating, engines, electric equipment etc. (Hossain et al., 2016). Bangladesh's largest ship breaking industry is located at Fozdarhat in Chittagong, which covers about 18 km of coastal area. Abandoned oil from ships, harmful chemicals are polluting the sea water. (Rahman et al., 2023). The severity of metal pollution in Sitakunda shipbreaking area is strongly noticeable. Heavy metals emitted from home, industrial, and other man-made activities may pollute natural aquatic systems to a large extent (Velez and Montoro, 1998). The biological balance of the recipient habitat and a variety of aquatic creatures may be severely impacted by heavy metal pollution (Farombi et al., 2007). According to Hugget et al. (1973), the identification of hazardous and poisonous compounds in water, sediments, and biota would thus provide direct insight into the extent of contamination in the aquatic environment. Estuaries and coastal zones are subject to pollutant input from both particular and non-specific sources. Specifically, these environments get metal input on a chronic basis from industrialised coastal areas such as seaports and cities. Since many different species of crustaceans live in estuaries, a great deal of research has been done to look at how different toxicants affect these creatures and how they bioaccumulate them (Bryan, 1971; Rainbow et al., 1990). According to Kamaruzzaman et al. (2012), heavy metals' toxicity, protracted persistence, and capacity to bioaccumulate and biomagnify throughout the food chain make them a serious threat to aquatic ecosystems. So, more research needed in this sector to know the present status of heavy metal in this area. For humans, crabs are a vital dietary and protein source. Comparatively speaking, it's critical to keep an eye on the metal levels in the reservoir because there is no official regulation over the wastewater that households and businesses dump into the river. To evaluate the safety of eating crabs, the concentrations of arsenic and chromium were tested in their gills, muscles, hepatopancreas, and whole bodies. Additionally, it could create a baseline for upcoming research on heavy metal contamination. These include the length of exposure, the environment's temperature, interacting agents, the animal's age and metabolic rate, and the metals' biological half-lives. There are more pathways for metal removal than absorption; yet, metal accumulates more quickly than it is eliminated, most likely due to tissues' existence of metal-binding proteins (Soegianto et al., 1999). For a long time, the effects of heavy metal exposure at work or in the environment on public health were mostly ignored, despite the fact that the abundance of these substances in our environment is still increasing (Mudipalli, 2008). Unfortunately, this problem has gone unnoticed by the relevant authorities and the general public in Bangladesh. Because eating crustaceans may put coastal residents' health at risk, it is crucial to ascertain the quantities of trace metals in these organisms. Some research works have been done in Bangladesh on heavy metal pollution in some important rivers of Bangladesh (Hossain et al., 2005; Hossain et al., 2016; Ahmed et al., 2015; Siddique and Aktar, 2012). But There is little information available on the bioaccumulation of trace metals in the most popular crustacean species and associated soil in the Bay of Bengal region. So the current study is monitoring heavy metal of *S. serrata* in Bhatiary area, Chattogram, and Chakaria, Cox's Bazar in Bangladesh. The study about edible crabs and related soil in Sitakunda shipbreaking area is noticeable. So, the current study aims to analyse heavy metals (Pb, Cd and Hg) in edible crab (*S. serrata)* and related soil. Different health-hazard parameters were also calculated to assess the marine environmental quality in this region concerning these pollutants, in addition to the health risks resulting from the consumption of the studied seafood.

MATERIALS AND METHODS

The levels of heavy metals were determined using an Atomic Absorption Spectrophotometer (AAS) and a standard analytical procedure. For the purpose of examining metals, the sample-collecting stage is essential. The majority of the time, samples were handled carefully to avoid contamination. The current study was conducted in Bangladesh's coastal areas (Bhatiary, Shitakunda, and Foujdarhat) and in Cox's Bazar (Figure 1). The area of Chattogram is located between 22.51^0 N to & 23.17^0 N latitude and 91.75^0 E to 91.98^0 E. The latitude of Cox's Bazar is between 21.42^0 N to 21.56^0 N and the longitude is between 92.0058^0 E to 92.0282^0 E. The samples were collected from Bhatiary, Shitakunda, Foujdarhat (Chattogram) and Cox's Bazar.

Sample collection

Adult mud crabs measuring 100 mm or more in carapace were procured from Bhatiary, Faujdarhat, Sitakunda, and Cox's Bazar. Following collection, the samples were completely cleaned in clean water, sealed in plastic bags, stored in an ice box, and then sent right away to the University of Chittagong's Faculty of Marine Sciences and Fisheries Laboratory. Then, the surface dirt from the collecting site—which was just a few centimeters deep—was packed into separate plastic bags, refrigerated, and delivered to the Faculty of Marine Sciences and Fisheries Laboratory at the University of Chittagong.

Preparation and digestion of tissue

Samples of abdomen muscle weighing 25 g were obtained by combining tissue from a total of 150 crabs (5 replicate samples from every point). After being oven-dried for 48 hours at 50°C, the tissues were ground into a powder. 1% nitric acid was used for the two rounds of digestion, with 2 mL and 10 mL in each cycle. Samples were heated to 60°C to aid in tissue breakdown and solvent evaporation. The samples were de-pigmented using hydrogen peroxide, and the products were then fully evaporated and redissolved in 25 mL of distilled deionized water (Jumawan et al., 2010).

Soil collection and preparation

Two g of soil from each duplicate was used after samples were taken using Van Veen Grab Sampler. Then, a three-step digestion procedure was carried out using 10 mL of concentrated hydrochloric/nitric acid (1:1), 10 mL of 3:1 hydrochloric/nitric acid, and 10 mL of 5% nitric acid. To aid in the breakdown and evaporation of acids at each step of digestion, a temperature of 40°C was applied. After being redissolved in 50 mL of 1% nitric acid, the final products were filtered (Jung, 2001).

Sample analysis

In order to optimise the flame condition and absorbance for the analysis, the atomic absorption apparatus was built. Next, inhaling into the flame in the AAS (Model-ICE 3300, Thermo Scientific, UK-designed, China-made) involved sample blanks as well as sample, standards, and blanks (deionized water). When calculating the concentration of different elements, an additional blank reagent was used, and the appropriate corrections were applied.

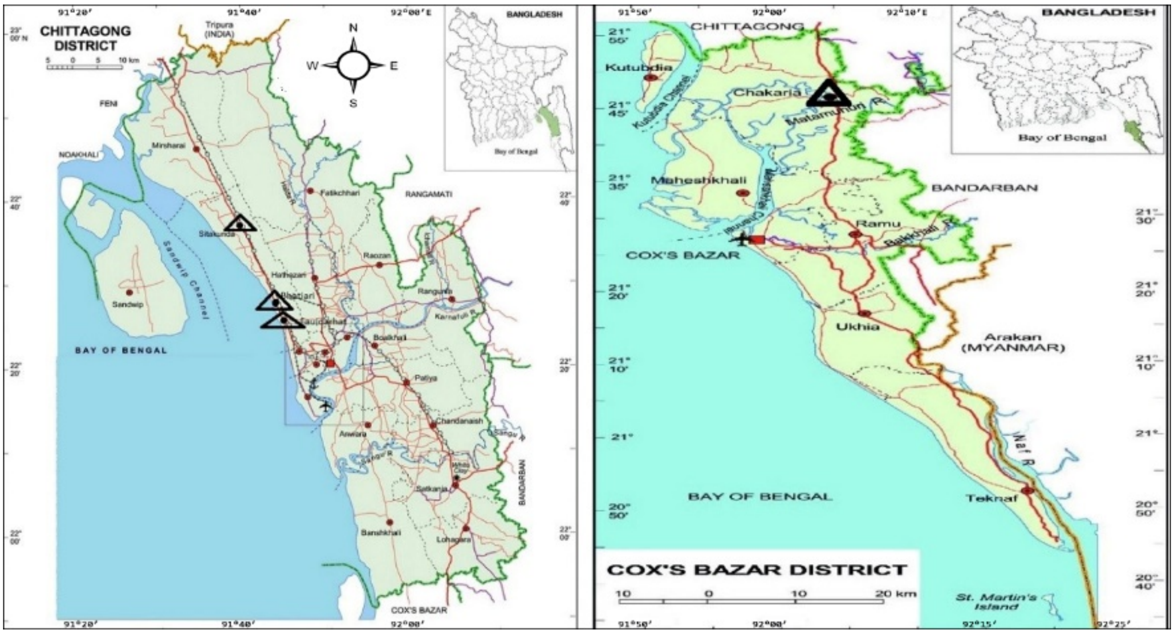

Figure 1. Study area map indicating sampling locations

Limit of detection and limit of quantification

The limit of detection (LOD) and the limit of quantification (LOQ) were used to determine the sensitivity of the flame AAS method. Based on the slope and response standard deviation, the LOD and LOQ were computed (Table 1).

Table 1. Limit of detection (LOD) and limit of quantification (LOQ) of the flame atomic absorption spectroscopy method (Vlad et al., 2019)

Parameter	Element		
	Pb	Cd	Hg
Linear working range (mg/L)	0-1	0-1	-
Limit of detection (mg/L)	0.012	0.083	-
Limit of quantification (mg/L)	0.039	0.276	-

Statistical analysis

To determine whether there are statistically significant differences in the concentration of heavy metals, one-way ANOVA was employed in this investigation. Using the statistical program of Microsoft Excel, the risk factors such as EDI & THQ were analyzed. All measurements were carried out at least five times.

Health risk assessment

The values of heavy metals concentrations in *Scylla serrata* were used to calculate the estimated daily and weekly intake, Target hazard quotient for metals and target cancer risk for the study area's people.

Estimated daily and weekly intake

The metals estimated daily intake (EDI) was determined using the daily intake in grams of mud crab soft tissue. The ingesting of seafood by coastal people was acquired from a previous study conducted by Soegianto et al. (2020), which showed a food ingestion rate (FIR) of around 140 g person^{-1}day^{-1}. The following equation was used for EDI:

$$EDI = \frac{C_m \times FIR}{BW_b}$$

Where C_m is the metal concentration in mud crab (mg.kg^{-1}), FIR is the daily food ingestion rate in grams per person per day, BW_b is an average body weight of Bangladeshi people which is taken as 49.5 kg (Ara et al., 2018; Uddin et al., 2019). The weekly intake of heavy metals (EWI) is derived by multiplying the EDI by seven days. To evaluate the risk of heavy metal food intake, the EWI values were compared to the provisional tolerated weekly intake (PTWI) standards presented.

Target hazard quotient for metals

The target hazard quotient (THQ) is the ratio of toxic metal intake to the reference dosage, which is the highest quantity at which no negative health effects occur. The THQ recognizes the hazardous metal in question's noncarcinogenic health risk. There should be no non-carcinogenic health consequences when the THQ is less than one. Negative effects on non-cancerous health outcomes might occur if the THQ is more than one. The THQ was determined using the U.S. EPA (1989) approach. THQ value was calculated using the equation-

$$THQ = \frac{C_m \times FIR \times E_f \times D_e}{RfD \times BW_b \times T_{avncar}}$$

Where, E_f denotes the frequency of trace element exposure (365 days year^{-1}), the exposure period is denoted by D_e (71.8 years), the food intake rate in grams per day for the corresponding type of food (mud crab) is denoted by FIR, C_m denotes the trace element's concentration in wet weight in the supplied food item, and RfD is the trace element's oral reference dosage. RfD values of Hg, Cd, Cr, Cu, and Zn were 0.3, 1, 3, 40, and 300 (g kg^{-1} BW day^{-1}) correspondingly (U.S. EPA, 1989). We implemented the RfD value for Pb from Hang et al. (2009), which is 3.5 g kg^{-1} BW day^{-1}. BW_b denotes the reference body weight of Bangladeshi people 49.5 kg, T_{avncar} denotes the averaged exposure period (365 days × 71.8 years).

RESULTS

Heavy metal concentration in the mud crab (*S. serreta)* and soil sample are diverse among stations.

Heavy metal concentration in the mud crab (wet weight)

The body tissue of the mud crab *S. serrata* varied somewhat in quantity depending on the site. The Pb, Cd, and Hg levels in crabs that were collected from several places in Chattogram and Cox's Bazar are shown in Table 2 and 3. Lead (Pb) concentrations in mud crab from the Chattogram coast region varied from 0.40 to 0.50 mg/kg (wet weight basis), whereas cadmium (Cd) concentrations ranged from 0.06 mg/kg (wet weight basis).

Table 2. The concentration of Lead (Pb), Cadmium (Cd), Mercury (Hg) in the body of Crab *S. serrata* (wet weight basis, mg/kg) collected from Chattogram coast

Station	Pb	Cd	Hg
1. Bhatirary	BDL	0.06	BDL
2. Shitakunda	0.40	BDL	BDL
3. Foujdarhat	0.50	BDL	BDL
4.Mean concentration	0.45	0.06	-

BDL= Bellow Detection Limit

Among the three metals tested for *S. serrata* from Chattogram coast area found that, Lead concentration was the highest (0.45 mg/kg) and Mercury concentration was the lowest (BDL). The sequence of heavy metal concentration were Pb (0.45 mg/kg) > Cd (0.06 mg/kg) > Hg (BDL). The highest concentration of Pb (0.50 mg/kg) in Foujdarhat area, Cd (0.06 mg/kg) in Bhatirary area. The sequence of metals in the station were represented in Foujdarhat (3) > Shitakunda (2) > Bhatirary (1) for *S. serrata*.

Table 3. The concentration of Lead (Pb), Cadmium (Cd), Mercury (Hg) in the body of carb *S. serrata* (wet weight basis) collected from Cox's Bazar coast

Station	Pb	Cd	Hg
1. Cox's Bazar	BDL	BDL	BDL

BDL= Below Detection Limit

Among the three metals tested for *S. serrata* from Cox's Bazar area, the concentration of all the three metals were found below detection limit.

Heavy metal concentration in the soil (wet weight)

There were some differences in the amount of heavy metals present in the soil sample between the locations. The levels of Pb, Cd, and Hg in crabs were taken from several locations in Chattogram and Cox's Bazar. In the Chattogram coast area, the mean concentration of heavy metals in the soil varied from 6.85 to 7.52 mg/kg for Pb (Table 4) and from 0.49 to 0.56 mg/kg for Cd.

Table 4. The concentration of lead (Pb), cadmium (Cd), mercury (Hg) in soil sample collected from Chattogram coast (mg/kg)

Station	Pb	Cd	Hg
1. Bhatirary	7.52	0.56	BDL*
2. Shitakunda	7.34	0.52	BDL*
3. Foujdarhat	6.85	0.49	BDL*
4. Mean concentration	7.23	0.52	-

*BDL: Below detection limit

Among the three metals tested for *S. serrata* from Chattogram coast area found that, load concentration was the highest 7.52 mg/kg and Mercury concentration was the lowest (BDL). The sequence of heavy metal concentration were Pb (7.23 mg/kg) > Cd (0.52mg/kg) > Hg(BDL).

Table 5. The concentration of lead (Pb), cadmium (Cd), mercury (Hg) in the soil collected from Cox's Bazar coast (mg/kg)

Station	Pb	Cd	Hg
1. Cox's Bazar	4.1	BDL	BDL

Among the three metals tested for soil samples from Cox's Bazar area, the concentration of all three metals was found that lead concentration was the highest (4.1 mg/kg) and other metal concentrations were found below the detection limit (Table 5).

Table 6. One-way ANOVA Result

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.169	2	0.0844	3.556	0.0958	5.143
Within Groups	0.142	6	0.0237			
Total	0.311	8				

DISCUSSION

The Chattogram Coast region (Bhatiary, Shtakunda, Faujdarhat) is a potential area of heavy metal pollution as it is the point of major ship-breaking yard and the coastal area of Sitakunda is polluted by both industrial and ship-breaking garbage, seeping traps and hence mangrove plant and fauna are susceptible to potential heavy metal pollution. The area of Cox's Bazar is also polluted by excessive tourist and human waste, waste of ships and trawlers mainly oil waste. Although the mean concentration of Pb in crab was higher than the other heavy metals, the study found that the mean concentrations of Pb (0.45 mg/kg), Cd (0.06 mg/kg), and Hg (0.45 mg/kg) in Chattogram and Cox's Bazar for crab were lower than the permissible limit of FAO/WHO (1995), Anonymous (2006) and FDA (1990-2012). The concentrations of heavy metal at the study area was not significantly high (p>0.05) compared to all stations (Table 6).

Target values are specified to indicate desirable maximum levels of elements in unpoluted soils compared to the FAO/WHO (1995) standard limit for Pb of 85.00 mg/kg (Table 7). All of the mean levels of these metals from the sample sites in the current investigation (mg/kg, wet weight basis) were less than the limit, with the exception of Cd (0.8 mg/kg). Table 8 lists the guidelines on trace metals for food safety for crab that have been established by several organisations.

Table 7. The heavy metal concentration (mg/kg) of soil in Chattogram coast Cox's Bazar and its comparison with International Standard and other regional studies

Elements	Target Value of Soil (mg/kg)	Chattogram Coast	Cox's Bazar
Pb	85	7.23	4.1
Cd	0.8	0.52	BDL
Hg	BDL	BDL	BDL

BDL= Below Detection Limit

Compared with the allowable limits for Pb (0.50 mg/kg), Cd (0.50 mg/kg), and Hg (0.50 mg/kg) established by the Ministry of Fisheries and Livestock Government of Republic Bangladesh (2014). Every sampling station's mean result for these metals in the current investigation was below the standard limit. The metal level is likewise below the FDA (1990–2012) and FAO/WHO's (1995) recommended guidelines for Pb, Cd, and Hg (Table 8).

Table 8. The heavy metal concentrations (mg/kg) in crab *S. serrata* and its comparison with national and international standards

Heavy metal	Ministry of Fisheries and Livestock (2014)	FAO/WHO (1995)	FDA (1990-2012)	EC (1881/2006)	Present study
Pb	0.50	0.50	-	0.50	0.45
Cd	0.50	2.00	-	0.50	0.06
Hg	0.50	0.50	0.65	0.50	-

The overall content of Pb and Cd in the soil was shown to be greater than that of the crab. This result confirmed that the Chattogram and Cox's Bazar costal region had clearly experienced bioaccumulation. It is evident that some heavy metals might be absorbed and stored by soil. Even while Chattogram and the Cox's Bazar coastal area have acceptable levels of heavy metal concentration in the soil and crabs, the rising levels of metals pose a serious threat to the ecosystem going forward.

Hutton (1987) suggested that Pb may be the cause of health issues in the hematological, neurological, and renal systems—the three organ systems that make up the human body. The amount of crab an individual consumes (g/weight) will likely determine the possible risks of metal transmission to humans. Pb exposure may result in a coma or perhaps death for the afflicted individual (Hutton, 1987). If an adult takes 10g of *S. serrata* per day from the Chattogram coast area, their daily intake of lead would be about 4.5 mg/kg (0.45 * 10 = 4.5 mg/kg). The user would ingest 31.50 mg/kg of lead if he consumed the crab for seven days. This is less than the FAO/WHO (1995) recommended threshold for the provisionally tolerated weekly intake of lead (50.00 mg/kg/adult). Likewise, an adult who eats crab from the same region will take in 4.2 mg/kg Cd over the course of seven days. Once more, this amount of intake is below the FAO/WHO (1995) permitted limits (6.70–8.30 mg/kg for adults). The human body eliminates cadmium at a relatively slow rate. The human body will accumulate copper if it is consumed over an extended period of time (Filov et al., 1993). According to Patnaik (1992), nausea, vomiting, diarrhea, headaches, stomach discomfort, muscle aches, salivation, and shock are the acute toxic symptoms of concentration of Cd intake. The concentration level of Pb (7.23mg/kg) in the soil of the Chattogram coastal area is lower than the permitted standards (85mg/kg) of FAO/WHO. But activity in Chattogram coastal area is concerning about increasing number of Pb and Cd in soil. In other hand Pb concentration level is lower in Cox's

Bazar coast. But it should need monitoring and awareness to control heavy metal pollution in Cox's Bazar coastal region.

All metal levels in mud crabs (*Scylla serrata*) from our study areas were lower than the maximum permissible amounts established by regulatory standards , PTWI (Table 9), and THQ regulations (Table 10). As a result, it seems safe for human health to consume mud crab (*Scylla serrata*) from this location based on the current available criteria.

Table 9. The EWI of metals by consuming mud crab (*Scylla serrata*)

Location	EWI of metal (µg kg^{-1})	
	Pb	Cd
Chattogram coast	8.90	1.19
The PTWI requirement (µg kg^{-1} BW)	25	7
References	EC (2001)	EC (2001)

Table 10. Estimated target hazard quotient (THQ) for studied metals examined in mud crab (*Scylla serrata*)

THQ	Metal	
	Pb	Cd
Chattogram coast	0.364	0.170
RfD (µg kg^{-1} BW day^{-1})	3.5	1

CONCLUSION

Crabs accumulate heavy metals (Pb, Cd, and Hg) to a significant degree. The purpose of this study was to find out more about the concentrations of heavy metals in crab and related soil from the southeast region of Bangladesh. Crabs showed a greater average content of cadmium, lead and mercury due to a unique bioaccumulation. This investigation made it clear that *S. serrata* and soil had heavy metal accumulations that were below nearly all international standard values. The quantity of heavy metals in Cox's Bazar is rather high, and soil, crustaceans, and the environment should all be monitored to guarantee safety. Although greater than in Cox's Bazar, the concentration levels along the Chattogram shoreline were still tolerable. If the concentration of heavy metals increases on a regular basis, it will become concerning. To identify the bioaccumulative heavy metal, this matter has to be thoroughly investigated.

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AUTHORSHIP CONTRIBUTIONS

Shipan Hossen: Conceptualization, Funding acquisition, Methodology, Writing- Original draft preparation. Mohammad Abu Sayed Chowdhury: Analysis, Writing- Review and editing. Rimu Das: Analysis, Writing- Reviewing and Editing. Md. Habibur Rahman: Supervision, Validation, Writing- Reviewing and Editing.

CONFLICTS OF INTEREST

I declare that the authors have no competing interests as defined by EgeJfas or other interests that might be perceived to influence the results and/or discussion reported in this paper.

ETHICAL APPROVAL

Not applicable.

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