International Journal of Synergy in Engineering and Technology
IJSET

Assessment of Heavy Metals Concentrations in Grouper Fish from Kertih Terminal and Tanjung Sulong Port, Terengganu, Malaysia

BadrulHaswan Besar [1,*], Safuan Hafizad [1]
[1] Fakulti Teknologi Kejuruteraan (FTK), University College TATI (UC TATI), Kemaman, Terengganu, Malaysia
[*]Corresponding author: badrul_haswan@uctati.edu.my

KEYWORDS

Heavy Metal
Grouper
WHO (1985)
MFR (2014)
FDA (2001)
Atomic Absorption Spectrophotometer (AAS)

ABSTRACT

Continuous exposure of heavy metals can lead to accumulation in fish and causes serious threats to human via food chain. Thus, the detection of heavy metal contamination in aquatic component is vital. The concentration of some heavy metals such as Pb, Cr and Zn in fish were determined. Grouper fish was collected from Kertih Terminal and Tanjung Sulong Port coastal area. The highest average level of heavy metal documented in fish is Pb followed by Cr, and Zn. The metal contamination found in this study was lower than WHO (1982) permissible limit except for Pb from Kertih and Tanjung Sulong bone sampling which is 2.0572 ppm and 2.0406 ppm, respectively, slightly exceeded MFR (1985) and FDA (2001) limit, which is 2.0572 ppm and 2.0406 ppm, respectively. In this work, only one time sampling was carried out. Thus, it is suggested to perform continuous monitoring to provide useful information regarding environmental situation.

1.0 INTRODUCTION

The influences of shipping, oil tankers, refineries, gas processing plant, petrochemical plant, land reclaiming activities, are the most pressing environmental problems that have caused decline of water quality in Kertih Terminal and Tanjung Sulong Port. As the soil and water polluted, it can affect the aquatic life. Fish can be vulnerable to toxic waste during its lifespan and can cause harm to consumers. The metal contamination in marine water is considered to be unsafe not only for fish but, also for human beings because they consume fish(Zanuri et al. 2020).

Fish is often at the top and main part of aquatic food chain. As a vital component of the human food, fish contains high protein content with the presence of omega-3 fatty acids, fats and vitamins with several minerals(Authman and Khallaf 2015). Prolong consumption of contaminated fish with heavy metal could pose significant health risks. This is because fish can signify a highly risk source of certain heavy metal. Fish have a tendency to accumulate heavy metal in a manner depending on their position in the food chain and their feeding habits.

The grouper fish is one of the most preferred species of fish in Malaysia(Piah, Kamaruddin, and Ambak 2018; Squalli 2020). The fish regularly dwells in the shallow coral reef areas for protection and feeds on assorted invertebrate fauna. As it matures, it moves to deeper soft bottom areas(Abdel-moneim et al. 2018; Azmi et al. 2018; Hazila et al. 2018; Piah et al. 2018). Terengganu was selected as sampling area because of its commercially landing of groupers in East Coast

Received April 2021; received in revised form May 2021; accepted June 2021

Malaysia(Ainn et al. 2019; Hazila et al. 2018). Meanwhile, the selection of Kertih and Tanjung Sulong waters as the sampling area was based on its main area of oil and gas industries in Terengganu(Adesina and Adelasoye 2014). With the above background, the aim of this present study was initiated to determine the concentration of heavy metals in grouper fish from Kertih Terminal and Tanjung Sulong Port.

2.0 EXPERIMENTAL PROCEDURE

2.1 SAMPLE COLLECTION AND LOCATION

The sampling of grouper fish was collected from two different locations at Kertih Terminal at Kertih (4.593087, 103.455930) and Tanjung Sulong Port (4.242085, 103.459137) at Teluk Kalong. Both locations are in Kemaman, Terengganu, Malaysia.

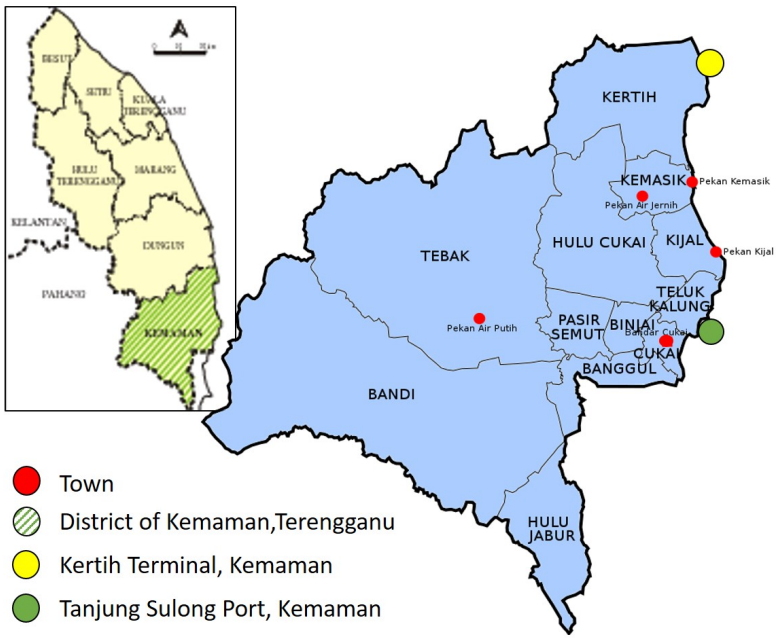

Figure 1: Sample point at Kertih Terminal and Tanjung Sulong Port in Kemaman, Terengganu, Malaysia

2.2 HEAVY METAL ANALYSIS

The fish samples were washed with distilled water and dried for 24 hours. The samples were later crushed using pestle and mortar to produce a powder form. 0.5 g of flesh and bone was placed in the Teflon bottle and 4 ml of concentrated Nitric Acid (HNO_3) and 1 ml of Perchloric Acid ($HClO_4$) were added. The samples were digested for 3 hours in the oven at 120 ^oC and diluted into 100 ml volumetric flask and made mark with distilled water. Then, diluted samples were analysed used Atomic Absorption Spectrophotometer (AAS).

3.0 RESULTS AND DISCUSSION

3.1 VARIATION OF HEAVY METALS IN GROUPER FISH BETWEEN AREAS

Fish has been considered good indicators for heavy metal contamination in aquatic systems because they occupy different trophic levels with different sizes and ages. Meanwhile, fish are widely consumed in many parts of the world by humans, and polluted fish may endanger human health.

3.2 ASSESMENT OF HEAVY METALS CONCENTRATION IN GROUPER FISH

Table 1: Comparison between heavy metal concentration in grouper fish samples and heavy metal permissible limit by WHO (1982), MFR (1985) and FDA (2001)

	Lead, Pb (ppm)	Chromium, Cr (ppm)	Zinc, Zn (ppm)
Kertih (Flesh)	1.8793	0.4669	0.6128
Kertih (Bone)	2.0572	0.4864	0.5292
Tanjung Sulong (Flesh)	1.9091	0.5661	0.5571
Tanjung Sulong (Bone)	2.0406	0.5184	0.5734
WHO (1982)*	5	1.2	100
MFR (1985)*	2	1	150
FDA (2001)*	1.5	-	150

* World Health Organization (WHO), Malaysian Food Regulations (MFR), and Food and Drug Administration (FDA)

3.2.1 LEAD (PB)

Table 1 shows that fish Bone from Kertih has higher Pb which is 2.0572 ppm than fish bone in Tanjung Sulong, 2.0406 ppm. For the fish flesh, the sample from Kertih contains Pb of 1.8793 ppm while from Tanjung Sulong was 1.9091 ppm. The permissible limit from WHO (1982), MFR (1985) and FDA (2001) state that the Pb level in seawater organism such as fish must not exceed than 5 ppm, 2 ppm and 1.5 ppm, respectively. Compared to the obtained results, all samples from two locations did not exceed the permissible limit set by the WHO. The results obtained from bone samples in Kertih and Tanjung Sulong was insignificantly higher than the permissible limit set by MFR (1985) and FDA (2001), which is 2.0572 ppm and 2.0406 ppm, respectively. Pb exist in water usually due to heavy industrial oil and gas activities around those areas such as crude oil drilling project, loading and unloading chemical product to shipping and toxic discharge from factory(Sayed, Saad, and Madany 1996). Consuming an excessive Pb can bring risk to nervous system, kidney and reproduction system. Pb also is considered one of the hazardous toxic metals(Adesina and Adelasoye 2014; Azlan et al. 2012). For safer human consumption, information on Pb accumulation is significant.

3.2.2 CHROMIUM (CR)

From Table 1, the chromium content in flesh sample from Tanjung Sulong had the highest concentration which is 0.5661 ppm. Meanwhile, flesh sample from Kertih is only at 0.4669 ppm. The Cr concentration from bone samples show differently which is 0.4864 ppm from Kertih and

0.5184 ppm from Tanjung Sulong. The content of Cr in all samples was lower than the permissible limit of Cr level in seawater organism set by WHO (1982) and MFR (1985) is 1.2 ppm and 1 ppm, respectively. Even though the Cr level in marine is low, continuous accumulation by aquatic organisms would cause serious threats to human wellbeing when they are consumed. The metal may exert some effects on ovarian physiology and ovulation(Authman and Khallaf 2015; Sharma and Singh 2015).

3.2.3 ZINC (ZN)

Zn is a crucial trace metal for both retarded growth and loss of taste leading to decreased fertility. Zn toxicity is rare, but at higher concentrations, it may induce toxicity. Table 1 shows that 0.6128 ppm of Zn existed in the fish flesh sample from Kertih while in bone was 0.5292 ppm. From Tanjung Sulong samples, the data show that the flesh and bone contain 0.5571 ppm and 0.5734 ppm, respectively. Zn concentration did not exceed allowable limit set by WHO (1982) which is 100 ppm while FDA (2001) and MFR (1985) states that the permissible limit is at 150 ppm.
The discharges from electroplating and textile industries, ship antifouling paints, agricultural runoff and vehicle emissions are few activities contribute to heavy metal contamination in marine sediments(Leung et al. 2014; Yunus et al. 2011). Consumption of contaminated fish could threaten human health since the toxic metals consequently accumulate in fish.

This heavy metal concentration analysis showed that Pb in grouper fish represents the possible risk to human health. Since Terengganu can be considered as a potential fish ground breeding for sustainable food security, it is necessary to control heavy metal levels in water, sediment and fish. The present study indicates that there are trends of higher Pb concentrations in fishes from Kertih and Tanjung Sulong. These results indicated that some source of heavy metals contamination is present in Terengganu coastal area especially Kemaman. Therefore, the long-term surveillance system of heavy metals in fishes should be done to provide useful information for the assessment of the potential health risks of metals in Terengganu, Malaysia.

4.0 CONCLUSION

Study of heavy metal concentrations in fishes is important in order to regulate the consumption of fish. The highest average level of heavy metal recorded in grouper fish is Pb. Present study clearly showed lower toxicity of various metal level in fish from Kertih and Tanjung Sulong. Hence, the fishes caught from Kertih and Tanjung Sulong would not cause serious toxicity in human when it is consumed. However, continuous monitoring system of heavy metals level in fishes would be vital and provide useful information for the evaluation of the potential health risks of metals in Kemaman, Terengganu, Malaysia.

REFERENCES

Abdel-moneim, Ashraf M., Mohamed A. Al-kahtani, Omar M. Elmenshawy, Hany Elsawy, Aly M. Hafez, and Marwa A. Genena. 2018. "Monitoring Metal Levels in Water and Multiple Biomarkers in the Grouper (Epinephelus Tauvina) to Assess Environmental Stressors on the Arabian Gulf Coast of Saudi Arabia." *Toxicology and Industrial Health*.

Adesina, Gabriel Olulakin and Kasali Amofe Adelasoye. 2014. "Effect of Crude Oil Pollution on Heavy Metal Contents , Microbial Population in Soil , and Maize and Cowpea Growth." *Agricultural Sciences* 5(1):43–50.

Ainn, Nor, Alfatihah Zamzuri, Muhammad Imzan Hassan, Artificial Reefs, Ground Breeding Area, Weighted Analysis, and Multi-criteria Decision. 2019. "POTENTIAL FISH GROUND BREEDING AREA BASED ON LOCALIZED CRITERIA." *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences* XLII(October):1–3.

Authman, Mohammad M. N. and Elsayed A. Khallaf. 2015. "Use of Fish as Bio-Indicator of the Effects of Heavy Metals Pollution Use of Fish as Bio-Indicator of the Effects of Heavy Metals Pollution." *J Aquac Res Development 2015,* (June).

Azlan, Azrina, Mohd Izuan, Effendi Halmi, Muhammad Radyaqsa, and Universitas Negeri Makassar. 2012. "Heavy Metals (Mercury, Arsenic, Cadmium, Plumbum) in Selected Marine Fish and Shellfish along the Straits of Malacca." *International Food Research Journal* 19(1).

Azmi, Nik-nurasyikin Nik Mohmmad, Nurulnadia My, Mohamad Sofi, Abu Hassan, and Tahirah Jaafar. 2018. "Metals Accumulation in Cultured Tiger Grouper , Epinephelus Fuscoguttatus with Estimated Weekly in Take Levels from East Coast of Peninsular Malaysia." *Journal of Sustainability Science and Management Volume* 13(5).

Hazila, N. O. R., Abdul Kadir, Rumeaida M. A. T. Piah, and Mohd Azmi Ambak. 2018. "Population Characteristics of Areolate Grouper Epinephelus Areolatus (Forsskål 1775) from Terengganu Waters , Malaysia." *Asian Fisheries Science* 31:276–83.

Leung, H. M., A. O. W. Leung, H. S. Wang, K. K. Ma, Y. Liang, K. C. Ho, K. C. Cheung, F. Tohidi, and K. K. L. Yung. 2014. "Assessment of Heavy Metals / Metalloid (As , Pb , Cd , Ni , Zn , Cr , Cu , Mn) Concentrations in Edible Fish Species Tissue in the Pearl River Delta (PRD), China." *Marine Pollution Bulletin Journal* 78:235–45.

Piah, Rumeaida Mat, Azrina Kamaruddin, and M. Azmi Ambak. 2018. "Analysis of Historical Landing Data to Understand the Status of Grouper Populations in Malaysia." *Malays. Appl. Biol.* 47(3):49–58.

Sayed, Hashim A. Al, Jalal Al Saad, and Ismail M. Madany. 1996. "HEAVY METALS IN THE GROUPER FISH EPINEPHELUS COIOIDES FROM THE COAST OF BAHRAIN: AN ASSESSMENT OF MONTHLY AND SPATIAL TRENDS." *Intern, J. Environmental Studies,* 50:37–41.

Sharma, Vani and Padma Singh. 2015. "HEAVY METALS POLLUTION AND IT, S EFFECT ON ENVIRONMENT AND HUMAN HEALTH." *International Journal of Recent Scientific Research* 6(12).

Squalli, Jay. 2020. "Evaluating the Potential Economic , Environmental , and Social Benefits of Orange-Spotted Grouper Aquaculture in the United Arab Emirates." *Marine Policy* 118(February):103998.

Yunus, Kamaruzzaman, Akbar John, Shahbudin Saad, and Said M. Al Barwani. 2011. "Bioaccumulation of Some Metals by Green Mussel Perna Viridis (Linnaeus 1758)." *International Journal of Biological Chemistry* 5(1):54–60.

Zanuri, N. B. M., M. B. Abdullah, N. A. M. Darif, and N. Nilamani. 2020. "Case Study of Marine Pollution in Teluk Bahang , Penang ,." *IOP Conf. Series: Earth and Environmental Science*.