MARINE ORGANISMS CONTAMINATION OF METAL IONS IN THE RED SEA OF SAUDI ARABIA

Omar M. L. Alharbi

Department of Biology, College of Sciences, Taibah University, Al-Medina Al-Munawara, Kingdom of Saudi Arabia

Abstract

Seafood is the main source of food in many countries due to its healthy nutrients. Fishes and grabs are essential sources of human body proteins. Moreover, omega 3 present in these animals is essential for the human brain and heart. Saudi Arabia is a growing country in the Gulf region and many people depend on the seafood obtained from the red sea. Marine pollution due to toxic metal ions is a natural phenomenon owing to anthropogenic and industrial activities. Consequently, fishes and grabs are always at risk with the assimilation of toxic metal ions in the marine system. The present study deals with the concentrations of the most toxic metal ions viz. Cr (III), Co (II), Hg(II), Pb (II), Se (II), Ba (II), Mn (II), Li (I), As (III), Al (III), Cd (II) Ni (II), V (III), Cu (II), Fe (II), and Zn (II) found in fish and grabs. Fishes and grabs were collected from three different locations of the Red Sea i.e. Yanbu, Al Qunfudhah and Jazan, Western Saudi Arabia. These metal ions were detected in the gills and muscles of all fish species (Sardinella longiceps, Carangoides spp, and Herklotsichthys spp.) along with crabs (Portunus pelagicus). The concentrations of Zn (II) and Fe (II) metal ions were higher in the gills of the grabs than in fishes. However, the concentrations are not exceeded the international permissible limits. The highest concentrations of the metal ions were found in Yanbu reason, which may be due to being close to the industrial area. In addition, the concentrations of V (III) and As (III) in the fish muscles collected from Jazan were high i.e. 6.435 and 3.291 mg/kg respectively. In Al Qunfudhah, the concentration of Cd (II) was high in the gill fish i.e. 0.08432 mg/kg. The lowest and the highest concentrations of metals were in fish muscles and gills, respectively. Therefore, the metal ions were accumulated in the gills. This study highlighted the toxicities of metal ions and their sources of contamination.

Keywords: *Marine organisms contamination, Metal ions, Toxicities, Saudi Arabia*

1. INTRODUCTION

The accumulation of metal ions is a universal problem in the plant, soil, water and seafood (Alharbi et al., 2018a; 2018b; Ali et al., 2005; 2020). Seafood is the main source in many countries around the world. The increasing human activities such as domestic, industrial and overgrowth of the population are increasing the production of metal ions. Among them, some of the metal ions are harmful to human beings; particularly arsenic, zinc, cadmium, cadmium, lead, etc. Many of them are contaminating our environment (Alharbi et al., 2018a; Ali et al., 2006). Most of the metal ions are accumulated, non-biodegradable and toxic to organisms; with some as carcinogenic (Jaishankar et al., 2014). It is important to mention here that many metal ions are long persistence in the ecosystem (Ali et al., 2005). Many metal ions are more toxic and harmful to human causing many diseases (Abohassan, 2013; Al Harbi et al., 2018b; Tchounwou et al., 2012).

The Red Sea is the longest coastline in Saudi Arabia containing many coastal cities, such as Qunfudhah, Jeddah, Jazan, Rabigh, and Yanbu. Jeddah and Yanbu are considered the most active cities in terms of the accomplishments and developments along the Saudi coast of the Red Sea. This sea is being targeted by metal ions contamination. Literature survey indicates some studies on metal ions in the Red Sea (Abohassan, 2013; Al Harbi et al., 2018b). Alharbi et al. (2018b) described high accumulations of metal ions in sediments and mangroves especially in roots and leaves at the Yanbu region at the Red Sea. Besides, many other papers describe metal ions contamination in Red Sea at Yanbu (Abohassan 2013; Alharbi et al., 2017; Badr et al., 2009; Sadiq and Zaidi 1994; Usman et al., 2013; Youssef et al., 2016) but these studies are not complete with little data. All these papers confirm a contamination of the read by toxic metal ions. Consequently, it is envisaged that these metal ions may be present in the sea animals, plants and sea food. The objectives of this study are to determine the concentrations of the most toxic metal ions *viz.* Cr (III), Co (II), Hg(II), Pb (II), Se (II), Ba (II), Mn (II), Li (I), As (III), Al (III), Cd (II) Ni (II), V (III), Cu (II), Fe (II), and Zn (II) in fishes and crabs collected from the Red Sea.

2. METHODS

Fish species and crabs were collected from Yanbu, Al Qunfudhah and Jazan, Western, Saudi Arabia. The sampling locations are shown in Figure 1. The inductively coupled plasma–mass spectrometry (ICP-MS) (model 7500) of Agilent, USA was used to detect the metal ions. Statistical analysis was applied by using a one-way ANOVA test to indicate the significant differences between the samples. The metal ions were detected as described somewhere else (Alharbi, 2018b). The tissues were weighed to take 500 mg. Then, added 6 mL of hydrogen peroxide (PanReac Applichem 30%) and 12 mL of nitric acid (Sigma- Aldrich 69%). Then, put the fish's tissue in H_2O_2 and HNO_3 on a glass beaker (250 mL) at the electric plate at 140 °C for 1.5-2 h. Then took the mixture of the fish's tissue that melted because of the H_2O_2 and HNO_3. After that, the filtering step was done by using filter paper and distilled water 50 mL. Because of the filtering step with funnels, the heavy metals passed across the filter paper under the tube. The samples were melted and put at the tube that had filter paper and put distilled water until it reached 50 mL. Then took the tube, which had heavy metals to test by Agilent Technologies 7500 Series ICP-MS. The standard procedure of ICP-MS analysis was followed for metal ions detection.

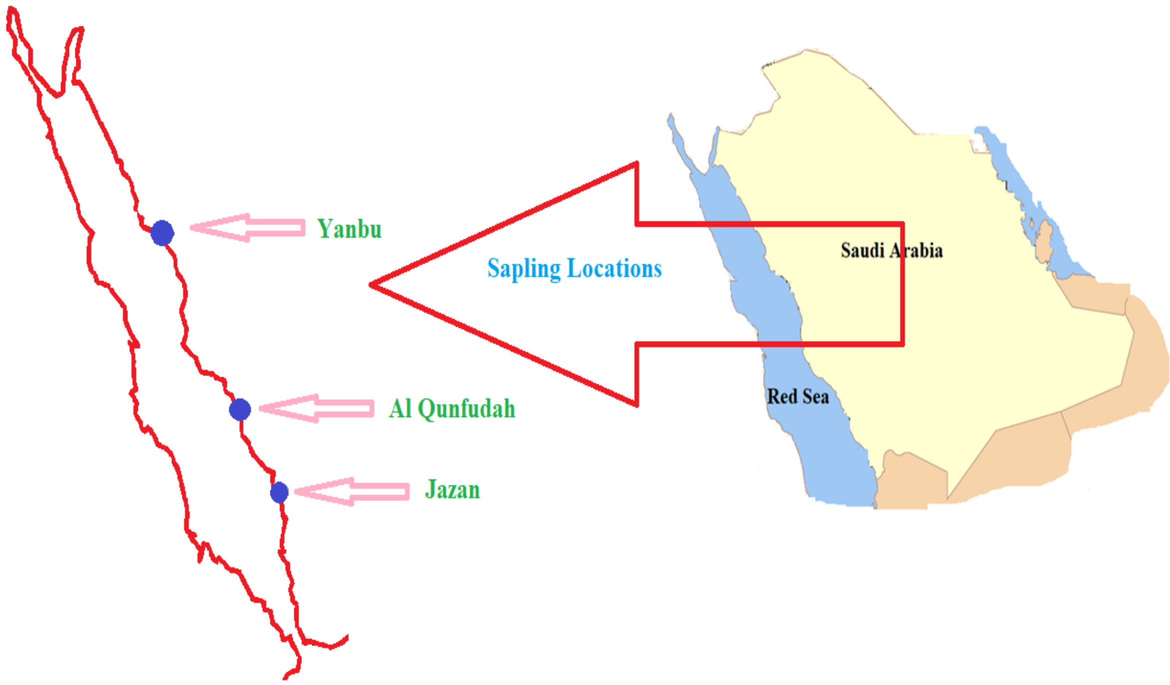

Fig. 1. The sampling locations.

3. RESULTS

The results of this study in terms of low and high concentrations of metal ions are given in the following section.

3.1. *The concentration of metal ions in fish species*

The results are shown a significantly different accumulation in gill and muscles for all metals at $p < 0.051$. The concentration of metal ions was high in the gill than muscles.

The fish species collected from Younbu are contaminated with high concentrations of Fe (II) and Zn (II) in gill 39.5, 2.7 mg/L, respectively. The concertation of metal ions in muscles was lower than in gills. Also, at Qunfudah city the concentration of Zn and Fe were significantly different at ($p < 0.05$). Figure 2 shows the high concentration of Zn (II), V (III), As (II), Fe (II) and Mn (II) in gill fish of the different species. The various concentrations were 5.7, 4.8, 2.5, 2 and 1.3 mg/kg, respectively. As well as the concentration of metal ions shown in gill fish species collected from Jazan city were significantly different at ($p < 0.05$). Figure 3 displays the high concentration of Fe, Zn (II) and Mn (II) and these were high in gill fish of different species at 2.4, 1.3 and 0.56 3 mg/kg, respectively.

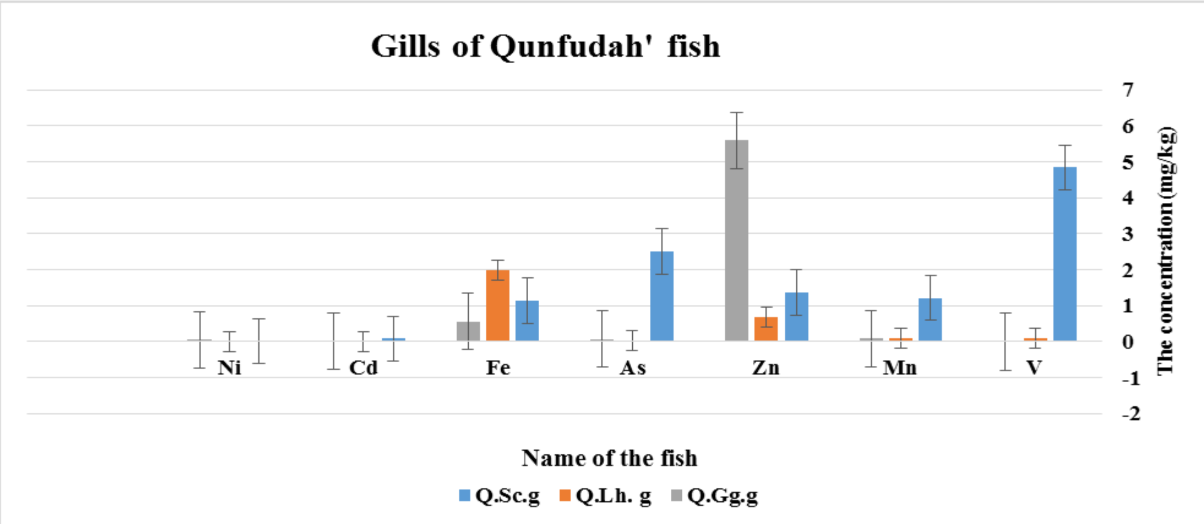

Fig. 2. Concentration (mg/kg) of different gill fish collected from Qunfudah city. Q= Qunfudah. J= Jazan. fish species: Sc=scaridae. Lh=Lethrinus hebulosus. Gg= Greasy grouper. Types of tissue: m= Muscles. G= Gill.

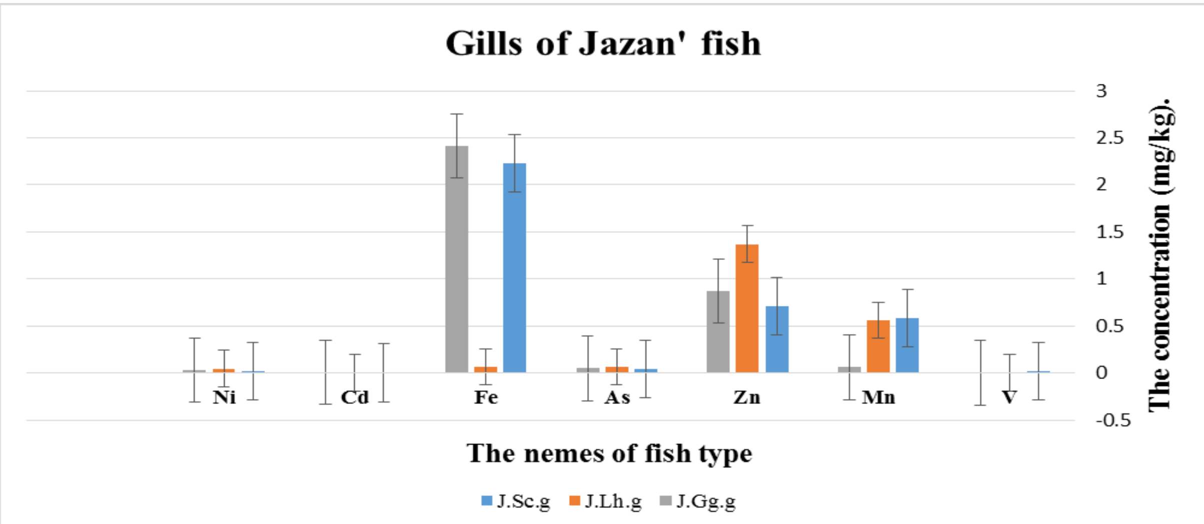

Fig. 3. Concentration (mg/kg) of different gill fish collected from Qunfudah city. Q= Qunfudah. J= Jazan. fish species: Sc=scaridae. Lh=Lethrinus hebulosus. Gg= Greasy grouper. Types of tissue: m= Muscles. G= Gill.

In addition, the concentrations of V (III) and As (III) in the fish muscles collected from Jazan were high *i.e.* 6.435 and 3.291 mg/kg, respectively. In Alqunfudhah, the concentration of Cd (II) was high in the gill fish i.e. 0.08432 mg/kg. The lowest and the highest concentrations of metals were in fish muscles and gills, respectively**.**

3.2. The concentration of metal ions in crabs and squid

The metal ions were detected and showed high concentrations in different types of tissues of crabs and squid. The concentration of some metal ions in crabs was high such as Zn, As and Co were 2.7, 0.7 and 0.24 mg/kg, respectively. In squid, the recorded high concentration of Cd was 0.65 mg/kg.

4. DISCUSSION

In this study, an assessment of the accumulation of metal ions in seafood as fish, crabs and squids was carried out. The results show the accumulation of some types of metal ions such as Cr (III), Co (II), Hg(II), Pb (II), Se (II), Ba (II), Mn (II), Li (I), As (III), Al (III), Cd (II) Ni (II), V (III), Cu (II), Fe (II), and Zn (II) in gills more than muscles. This is because many marine organisms breath through gills and are exposed to pollution. Therefore, the gills are more contaminated than others. The metal ions like Zn (II), Co (II), Fe (II), V (III) and Cd (II) accumulated in the gills of some types of organisms; causing the disease to the organisms themselves. The concertation of metal ions of Fe and Zn in gill were 39.5, 2.7 mg/L, respectively. Yanbu city registered high concentration than Qunfudah and Jazan. It is due to the act that this city is an industrial city but not higher than Jeddah city according to Younis et al. (2015); where the authors recorded the concentration of Zn (II) was more than 10 mg/l in gill fish species. The result of this study was compared with international studies (Alharbi et al., 2018a; Alharbi et al., 2018b) and showed the results are under the limit of stander and safe for food.

5. CONCLUSIONS

In conclusion, high concentrations of Zn (II), Fe (II) and As (III) were detected in gills more than in muscles and tissues in all marine species by using ICP-MS after biological preparation methods. Yanbu city was registered high concentration of metal ions than Jazan and Qunfudah. However, the observations of results were under the limit of stander according to (FAO, 1983). Many heavy industrial activities without considering the marine environment drive more pollution and increase the metal ions in the environment. Therefore, this affected the seafood by increasing the accumulation in the marine organisms. It may be concluded that the sea-food may be more contaminated with toxic metal ions in near future. There is a great demand for treating industrial wastewater before discharging.

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