Potential risk of some heavy metals in *Pampus chinensis* (Euphrasen) Chinese silver pomfret Stromateidae collected from Karachi Fish Harbour, Pakistan

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Abstract Mn, Fe, Co, Cu, Zn and Pb levels were studied in muscle and liver tissues of *Pampus chinensis* from Karachi Harbour as is the most important fishery area in Pakistan to estimate the potential risk of human consumption. The fish samples were collected monthly from Karachi fishing ports during January-December 2013. Significant differences in metal concentrations were found between different months (P<0.05). Results showed that order of decreasing concentrations was Fe> Zn> Cu> Pb in tissues. The liver metal concentrations showed the highest values, whereas the muscle concentrations were the lowest one. The mean (±SE) concentrations of Mn, Fe, Co, Cu, Zn and Pb in the muscles were 0.95±0.08, 29.32±2.04, 0.13±0.02, 2.28±0.12, 4.00±0.20 and 0.36±0.03 mg/kg; dry wt, respectively. The mean (±SE) liver concentrations of Mn, Fe, Co, Cu, Zn and Pb were 3.08±0.27, 414.30±18.07, 0.85±0.06, 3.27±1.67, 43.24±2.61 and 0.77±0.07 mg/kg; dry wt, respectively. None of the metals exceed the threshold limits for fish imposed by European Commission Regulation and other international organizations. This study also demonstrated that estimated daily intakes of selected metals via consumption of fish were below the Permissible Tolerable Daily Intake values established by FAO/WHO.

Keywords Heavy metals; *Pampus chinensis*; Karachi Fish Harbour; Pakistan; Permissible Tolerable Daily Intake

Introduction Marine pollution is growing at a danger level and has become an important global problem. One of the most important pollutants is heavy metals. Their levels in coastal waters from both natural and anthropogenic sources have impacted on the ecosystem health and economic status of populations. Heavy metal contaminations may also affect the ecological balance of the receiving environment and the diversity of aquatic organisms (Farombi et al., 2007). Heavy metals consist of both biological essential and non-biological essential metals are known to be potentially toxic living organism (Bryan, 1976). An increase in the levels of available heavy metals in the coastal ecosystems may result in an increase in the levels of metal taken up and thus accumulated by organisms (Phillips and Rainbow, 1994; Rainbow, 1995). Fish are widely used to evaluate the health of marine ecosystems because heavy metals transfer via food chains and they are responsible to accumulate in liver and even in edible tissues of fish (Bat, 2014). This can lead to deleterious effects on fisheries and potentially public health.

Karachi Harbour is the most important fishing area in Pakistan (Siyal et al., 2013). In addition, of the numerous industrial, sewage and agricultural wastes reach the Karachi coastal area through some rivers that are heavily polluted in several places. The dumping of wastes in the coast provides a significant source of heavy metal input (Khattak et al., 2012; Mukhtar and Hannan, 2012; Ahmed et al., 2015). As fish is an important and high protein source of food for people all over the world (Pawar and Sonawane, 2013), this in itself imposes a need for detailed investigation of metal pollution and control of their levels (Patin, 1982). *P. chinensis* is carnivour fish (Last, 1997) and plays important role in food chains. Chinese silver pomfret are consumed in fresh (Last, 1997).

The aims of this study were to: 1) Measure Mn, Fe, Co, Cu, Zn and Pb in *P. chinensis* collected from Karachi coastal waters monthly during 2013, 2)
Describe if Mn, Fe, Co, Cu, Zn and Pb levels were significantly different between months, 3) Determine if these heavy metal levels were significantly different between dorsal and liver tissues, and 4) Compare any Mn, Fe, Co, Cu, Zn and Pb levels present with the guidelines set down European Commission Regulation and FAO/WHO for the safe consumption limits of *P. chinensis*.

1 Materials and Methods

Fish samples were collected monthly from Karachi Harbour during 2013. The samples were prewashed with clean sea water at the point of collection and packed in polyethylene plastic bags. The collected samples were kept in ice box and transferred to the Fisheries Laboratory of the Marine Reference Collection and Resources Centre, University of Karachi. The total length (TL) of all fishes were measured by using wooden measuring tray (nearest 0.1 cm) and weighed (W) by electronic balance (nearest 0.1g). There were Six individuals from each month were chosen, rinsed with sea water, placed in plastic bags and freezed at -21°C until the analysis. Both muscle and liver tissues of the fish were prepared for analysis according to the method described by Bernhard (1976). All samples of dorsal muscles and entire liver tissues homogenised and dried in an oven until constant weight was obtained. Samples were then ground and calcinated at 500°C for 3 hours until it turned to white or grey ash and digested with HCl (Gutierrez et al., 1978). The filtered extracts diluted with 1 N HNO3 (UNEP, 1984 and 1985). All reagents used during analysis were of analytical reagent grade. Calibration of the instrument was done by standard solutions. The solutions were analysed by using the equipment (Analyst 700) with background correction and acetylene as fuel and were prepared programme win lab 32 software for Mn, Fe, Co, Cu, Zn and Pb. The heavy metal analyses in the fish samples were recorded as means ± standard error (SE) of triplicate measurements. The values of heavy metals are expressed as mg/kg dry wt. of the sample. Statistical analysis (ANOVA) was performed to test the differences between seasons and Tukey test was used to determine the differences (Zar, 1984).

2 Results

The mean lengths (cm) and weights (g) of *P. chinensis* from Karachi Harbour was given in Figure 1 during January - December 2013. The lengths and weights of collected fish samples ranged from 21 to 36 cm and 96 to 208 g, respectively. There was no statistical difference (p>0.05) both lengths and weights between months.

![Figure 1 Lengths (cm) and weights (g) of the Chinese silver pomfret *Pampus chinensis* from Karachi Harbour between January and December of 2013](image)

The Figure 2 showed that Fe concentrations were the highest followed by Zn and Cu; Pb being the lowest in the tissues both muscle and liver. Similar results for different fish species were found by many researchers (Tepe et al. 2007; Türkmen et al. 2008 and 2009). Since essential metals play important roles in biological systems (Türkmen et al. 2009) and metal uptake rates are positively related to the metabolic rate in fish. Analysis of variance (ANOVA) indicate that the concentrations of all measured heavy metals were considerably higher in liver tissues of *P. chinensis* than those in muscle tissues (P<0.05) and that there was a statistically significant difference between the concentrations of the metals among months. It may be suggested that the monthly variations of these metals in the Chinese silver pomfret are attributed to physiological conditions, environmental variations and feeding activity.

3 Remarks

Fish are very good bio-indicators because of their rates of growth, body sizes, life strategies and food preferences (Jakimska et al., 2011). If fish are exposed to polluted waters with various metals, the biologically available metal ions are up-taken through gills and skin or through the ingestion of contaminated food. Canli and Atli (2003) showed that target tissues of heavy metals are metabolically active organs especially liver compare to the lower metabolism tissues like muscle tissues. Thus metals are accumulated in the organ of metabolic activity like liver, their deposition also occur later in the muscle
tissues. *P. chinensis* is benthopelagic and amphidromous fish (Riede, 2004). They occur seasonally singly or in small schools over muddy bottoms and prey on mainly ctenophores, salps, jellyfish, zooplankton and small benthic organisms (Last, 1997). Therefore it may be suggested that *P. chinensis* is also very good bio-indicator for monitoring heavy metals in coastal waters.

Legal thresholds are not available for essential metals in Europe. However, in the muscle tissues of fish the average Zn and Cu concentrations were on average below the maximum tolerance levels for human consumption established by compared the international legislation (MAFF, 1995). Mean concentration of Zn (1.67±0.2 mg/kg dry wt.) found in *P. chinensis* is less than 50 mg/kg wet wt., well below the guideline level (MAFF, 1995). Cu concentrations in the Chinese silver pomfret were low (mean Cu concentration was 1.05±0.12 mg/kg dry wt.) and also quite below the guideline level of 20 mg/kg wet wt. (MAFF, 1995). Whereas these metal levels were high in the fish samples at some months (Figure 2). This should not be any problem because of liver is not consumed and the average concentrations of Zn (22±2.6 mg/kg dry wt.) and Cu (14±1.66 mg/kg dry wt.) in the liver are lower than permissible levels. The tolerable values of non-essential metal Pb are indicated by Commission

Figure 2 Zn, Mn, Cu, Co, Fe and Pb levels in the Chinese silver pomfret *Pampus chinensis* from Karachi Harbour between January and December of 2013
Regulation (EU) and Aquatic Environment Monitoring Report as 0.30 and 2 mg/kg wet wt. (Official Journal of the European Union, 2006; MAFF, 1995). In the present study the mean Pb level in the muscle tissues is 0.25±0.03 mg/kg dry wt., indicating that these values are below the guideline levels. The mean Pb level in the liver is 0.57±0.07 mg/kg dry wt. which seems that it is higher than guideline levels for European Commission Regulation (Official Journal of the European Union, 2006). It should be noted that the metal levels of Commission Regulation were given as mg/kg wet wt. According to FAO estimates of fish consumption in Pakistan is 5 g per person (FAO 2010). This is also equivalent to 35 g/week. Internationally accepted safe levels of Zn, Cu and Pb are 7 mg, 3.5 mg and 0.025 per kg body weight per week for the Provisional Tolerable Weekly Intake (PTWI), respectively (FAO/WHO, 2010). These are equivalent to 490 mg/week/70 kg body weight and 70 mg/day/70 kg body weight for Zn; 245 mg/week/70 kg body weight and 35 mg/day/70 kg body weight for Cu; 1.75 mg/week/70 kg body weight and 0.25 mg/day/70 kg body weight for Pb. Estimated Daily Intake (EDI) for a 70 kg body weight of an adult person on basis of the muscle tissues results were calculated as 0.008±0.001 for Zn, 0.015±0.0006 for Cu and 0.0013±0.0002 for Pb. Thereby there is no health threatening concern due to the consumption of edible parts of the Chinese silver pomfret from Karachi Coastal waters of Pakistan.

4 Conclusion
Generally, fish liver was found to have the highest significant levels of metals. Therefore, the monitoring of the fish is important with respect to toxic metals affecting human health. However the estimates of PTWI and EDI indicated no health risk as values are lower than the allowed tolerable levels cited by international committees. Thus, it can be concluded that metals bioaccumulation in the Chinese silver pomfret are below the permissible limits set for heavy metals by FAO/WHO (2010).

Author’s contributions
QA designed the experiment, carried out the fish sampling in Karachi Harbor and measured the heavy metals. LB analyzed data and made figures and tables and finalized the manuscript. Both authors read and approved the final manuscript.

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