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Metals Contamination in Edible Carnivorous Fishes of Arabian Sea

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Abstract: A potential hazard to Clifton beach Karachi was revealed due to accumulation trend of heavy metals in fishes of Arabian Sea with oil pollution by Tasman spirit. Concentration of heavy metals like Hg, Cd, Cr, Pb and As were determined in five common edible carnivorous fishes to calculate the accumulation factor and to establish a basis for environmental protection. The measurements of the metal levels were carried out using atomic absorption spectroscopy. The metal accumulation in the liver, gill, gut and gonads were found to be quite high in comparison with the muscle. All metals studied alter gill filament structure but Pb damage was more prominent

Key words: Oil pollution, heavy metal, carnivorous fish, gills

INTRODUCTION

The pollution of the sea (Cole, 1979) from oil due to major accident like Exxon Valdez (1989), the Barer (1993) or the deliberate release of oil as observe during Gulf War (1991). However in Pakistan oil spreading by Tasman spirit was the major disaster happen in July 2003.

The amount of oil spill is only one factor in determining how much damage is caused. The Exxon Valdez was carrying 35,000 tones of oil and resulted in about 30,000 known seabird's deaths. Heavy seas broke up the light crud oil from the barer and prevented slicks forming, thus reducing the number of death of fishes and seabirds as well as mammals. Presently a significant portion of the global diet consists of foods of aquatic origin, either fresh or processed and from fresh or salt water (Florence *et al*., 1992; Vos *et al*., 1986). The need to include seafood especially fish in the human diet has been emphasized with regards to its lower levels of saturated fat, cholesterol and caloric intake compared with meat, poultry and dairy product but we should investigate the attendance of environmental contaminates especially oil with regards to heavy metals in fish and other seafood products (Datta and Sinha, 1989). There are some examples of bioaccumulation of metals compounds like Hg, As, Cd, Pb and Cr having no biological function (Sinha *et al*., 2002; May and Mekinney, 1981; Castagna *et al*., 1981; Engman and Jorhan, 1998). In Japan, industrial discharge of mercury into Minamata Bay raised the concentration of the metal in fish, resulting in serious toxic effects and deaths following consumption of the contaminated fish. The level of Hg reaches the value of 10-100 $\mu g\ g^{-1}$ in sediments and 5-40 $\mu g\ g^{-1}$ in fish and mollusks. (Swan, 1998; Villanueva and Botello, 1998)

The Clifton beach experience has indicated that the most serious sources are oil spreading and industrial discharge and it is most dramatic example of environmental contamination by heavy toxic metal (Azmat *et al*., 2006a) and carcinogenic hydrocarbon (Liven and Roony, 2003). The aim of the present study was to investigate the potential impact of oil pollution at Clifton beach Karachi with regard to elemental and hydrocarbon pollution on the surrounding environment, which involves the death of thousands of fishes at Clifton beach after passing one of oil spreading (Azmat *et al*., 2006b). The present study will examine the effect of oil pollution with respect to toxic heavy metals in edible fishes of Arabian sea in relation with human health risk.

MATERIALS AND METHODS

Five common edible species (*Pomadasys olivaeum*, *Pomadasys maculatum*, *Pomadasys commersonni*, *Arius thalssinus* and *Otolithus ruber*) targeted for investigation of heavy metals collected from fishery, Mossa Colony and Korangi Creak in 2005. The fishes were identified and subjected to heavy toxic metal analysis in fresh muscle, liver, gill, gonads and gut. Heavy metal analysis was carried out by using method of atomic absorption spectrophotometry.

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Preparation of samples: External surface of fishes were washed with deionized water and kept in filter papers for removal of water molecules and placed at 4°C for dissection. The internal organs (flesh, gill, gonads, guts and liver) digested by adding concentrated H_2SO_4 and HNO_3, which convert the solid material into liquid formed and this was further diluted to 50 mL by adding deionized water (Halvim and Saltanpour, 1980; Akhtar *et al*., 2005)

RESULTS AND DISCUSSION

Spilled oil adversely affected about 10 km shore line. The beach sand in this area was found contaminated with oil. Samples of sea sand were tested and found contaminated with heavy metals like, Ni, V, Cd, As, Hg and Pb. The oil spill incidence has occurred in the breading season. Presence of oil in sea for long time will adversely affect new bread. KPT claims that fishing is being done in the west side and in the deep sea where no oil exists. But expert's opinion is different. They claim that spilled oil will travel to fishing zone in during course of time depending on the wind direction (News from TV and print media).

Heavy metal contamination in seafood is of great concern in places suffering from pollution. Therefore Marine pollution has been studied under the following grouping of effects; harm to living resources, hazards to human health, reduction of amenities and interference with other users of the sea (Tam and Mok, 1991). A systematic examination of a large number of specimen of fishes ranking of their quality level indicated that a lack of quality control procedures after results in high or varying results (Engman and Johan, 1998). The investigated fishery products included *Pomadasys olivaeum, Pomadasys maculatum*, *Pomadasys commersonni*, *Arius thalssinus* and *Otolithus ruber* in which the elements like, Zn, As, Cd, Hg and Pb were determined (Table 1 and 2) in different parts. The results were compared with the data from the literature and with the trace elements levels usually found in other animals products.

Gills tissue respiration rates of fishes effected by a decrease of gill oxygen uptake due to the accumulation of toxic metals but effect is more prominent by Pb as compared to Cd and Hg therefore, fishes experience more rapid death as observed at Clifton beach in 2005 (Azmat *et al*., 2006a). Metal analysis of gill, liver, gonads and guts shows that these organs accumulated the Pb more than other muscle tissues. It is also mostly released from vehicles and industrial smoke. In humans exposure to Pb can result in a wide range of biological effects (Akhtar *et al*., 2005; Gulfraz and Ahmed, 2001) depending on the level and duration of exposure. Lead poisoning, which is so severe as to cause evident illness, is now very rare indeed. At intermediate concentration, however, there is persuasive evidence that Pb can have small, subtle, sub clinical effects, particularly on neuro psychological developments in children. Mercury (Swan, 1998), or its compounds have been used in industry, as fungicides in agriculture and horticulture. Methyl mercury is usually enriched in aquatic food chains, affecting fish and trace amounts are found in nearly all fish and for most fish this ranges from 0.01 ppm to 0.5 ppm with an average of less than 0.3 ppm for commercially important marine species (Villanueva and Botello, 1998).

The symptom of methyl mercury poisoning strongly indicates that the tissues most severely affected are in the nervous system, specially the brain tissues. Hg accumulates in kidney, liver and the nervous system, causing damage and poisoning symptoms.

Cadmium is biopersistant and once absorbed by an organism remains resident for many years (Over decades for human) although it is eventually excreted. Cadmium derives its toxicological properties from its chemical similarity to Zn, an essential micronutrient for plants, animals and human. Cd an ion effects on respiration and binders in exchange of gases. The concentration of Cd (Hmod, 1995) in the liver by far exceeded the concentration in the muscle tissue, for all investigated carnivorous species. Cd in fish is absorbed both from the surrounding water by the gills and from the food by digestion and these transported by the blood, mainly to the liver and kidney in these both organs Cd is bind to certain proteins, melalthionenenis. The Concentration of both harmful metals, Hg and Cd however constitute a potential rich to human. The most important pollutant resources of Pb are dying factory, refinery and battery making. The present study showed that the amount of Pb was higher than acceptable limit. The metal concentration in the liver and gonads were found to be quit high in comparison with muscle (Ogindo, 2001). The significantly higher concentration of these toxic elements in the hepatic tissue from the exposed site, suggesting with the measurements of oil spreader pollutants as a probable source of these elements (Zyadah and Chouikhi, 1999). Arsenic (As) concentration is reported in all fishes selected for investigation because it is mostly present on surface of water which can alter genetic material of fishes (Azmat *et al*., 2006). As may cause serious diseases of blood by reduction of red and white cells.

Table 1: Heavy metal concentration (μg g^{-1}) in muscle of five common edible carnivorous marine fishes

Name of species	Pb	As	Cd	Hg	Zn
Pomadasys olivaeum	0.081±0.01	0.28±0.01	0.191±0.01	0.34±0.01	0.412±0.01
Pomadasys maculatum	0.291±0.01	0.21±0.01	0.215±0.01	0.41±0.01	0.312±0.01
Pomadasys commersonni	0.321±0.01	0.31±0.01	0.31±0.02	0.32±0.01	0.113±0.01
Arius thalssinus	0.41±0.02	0.21±0.01	0.34±0.03	0.11±0.01	0.145±0.01
Otolithus ruber	0.01±0.02	0.11±0.01	0.23±0.02	0.11±0.01	0.321±0.01

Table 2: Heavy metal concentration (μg g^{-1}) in gills, gonads, livers and guts of five common edible carnivorous fishes

	Gills				
Name of species	Pb	As	Cd	Hg	Zn
Pomadasys olivaeum	0.451±0.01	0.118±0.05	0.11±0.01	0.35±0.01	0.321±0.01
Pomadasys maculatum	0.212±0.01	0.23±0.02	0.12±0.01	0.23±0.01	0.332±0.01
Pomadasys commersonni	0.423±0.01	0.24±0.02	0.31±0.01	0.45±0.01	0.325±0.01
Arius thalssinus	0.454±0.02	0.15±0.04	0.41±0.01	0.36±0.01	0.412±0.01
Otolithus ruber	0.312±0.02	0.21±0.01	0.3±0.01	-	0.400±0.03
	Gonads				
Pomadasys olivaeum	0.321±0.01	0.03±0.01	0.21±0.01	0.11±0.02	0.012±0.01
Pomadasys maculatum	0.010±0.02	0.01±0.01	0.12±0.02	0.23±0.02	0.001±0.001
Pomadasys commersonni	0.110±0.01	0.04±0.01	0.11±0.01	0.14±0.02	0.202±0.01
Arius thalssinus	0.321±0.01	0.05±0.01	0.10±0.02	0.12±0.02	0.021±0.1
Otolithus ruber	0.007±0.01	0.12±0.01	0.003±0.01	0.13±0.01	0.12±0.01
	Liver				
Pomadasys olivaeum	0.221±0.01	0.321±0.01	0.04±0.01	0.1±.0.01	0.02±0.01
Pomadasys maculatum	0.011±0.01	0.112±0.01	0.021±0.01	0.2±0.01	0.31±0.01
Pomadasys commersonni	0.110±0.01	0.04±0.01	0.11±0.01	0.14±0.02	0.202±0.01
Arius thalssinus	0.321±0.01	0.321±0.01	0.012±0.01	0.1±0.02	0.15±0.01
Otolithus ruber	0.006±0.01	0.41±0.01	0.11±0.02	0.2±0.01	0.31±0.01
	Gut				
Pomadasys olivaeum	0.12±0.01	0.23±0.01	0.06±0.01	0.12±0.01	0.01±0.02
Pomadasys maculatum	0.031±0.01	0.21±0.03	0.011±0.01	0.16±0.01	0.31±0.01
Pomadasys commersonni	0.002±0.02	0.01±0.01	0.021±0.01	0.20±0.01	0.02±0.01
Arius thalssinus	0.019±0.02	0.02±0.01	0.011±0.01	0.11±0.01	0.31±0.03
Otolithus ruber	0.031±0.01	0.12±0.01	0.022±0.02	0.11±0.01	0.32±0.01

Heavy metal Zn used in industries as a ingredients for manufacturing of pipes, tin can and many other product (Lakshmi and Probhakara, 2002). The continues discharged of this metal increased the pollution of sea and one of the major factor which involves in the accumulation in various parts of fish which is attributable for the weakness of fish through an ionic changes in tissues and blood. Zn concentration is more in gill, which is comparable with reported value of Yuka *et al.* (2001).

CONCLUSIONS

Heavy metal toxicity is frequently the results of long term low level exposure pollutants common in our environment. Recent results revealed that even low levels of Pb, Hg, Cd and As can create wide variety of health problem by regular in take of contaminated fish.

REFERENCES

Azmat, R., S.S. Rizvi, R. Talat and F. Uddin, 2006a. Macronutient found in some edible herbivorous and carnivorous fishes of Arabian sea., J. Biol. Sci., 6: 301-304.

Azmat, R., Y. Akhter, R. Talat and F. Uddin, 2006b. Persistent of Nematode parasites in presence heavy metals found in edible herbivorous fishes of Arabian Sea. J. Biol. Sci., 6: 282-285.

Akhtar, N., T. Ahmed, M. Gulfaraz and R. Khanum, 2005. Adverse effects of Metal ions pollution on aquatic biota and seasonal variation. Pak. J. Biol. Sci., 8: 1086-1089.

Castagna, A., F. Sarro, F. Sinatra, V. Capodicasa and M. Scalia, 1981. Heavy metal concentration in various species fished from the Gulf of Catania. Bull. Soc. Ital; Biol. Sper., 30: 621-627.

Cole, H.A., 1979. Pollution of the sea and its effects. Proc. R. Soc. Lord B. Biol. Sci., 18: 17-30.

Datta, D. and G.M. Sinha, 1989. Responses induced by long term toxic effects of heavy metals on fish tissues concerned with digestion, absorption and fish tissues concerned with digestion, absorption and excretion. Gegerbaurs Morphol. Jahrb., 135: 627-657.

Engman, J. and L. Jorhan, 1998. Toxic and essential elements in fish from Nordic waters, with the results seen from perspective of analytical quality assurance. Food Addit. Contam, 15: 884-892.

Florence, T.M., G.M. Morrison and J.L. Stauber, 1992. Determination of trace element speciation and the role of speciation in aquatic toxicity. Sci. Total Environ., 7: 1-13

Gulfraz, M. and T. Ahmad, 2001. Concentration level of heavy and trace metals in the fish and relevant water from Rawal and Mangal Lakes. Pak. J. Biol. Sci., 5: 414-416.

Halvin, J.L. and P.N. Soltanpour, 1980. A nitric acid plant tissue digestion method with ICP spectrophotometry for contaminates. Soil Plant Anal. Chem., 11: 960-980.

Hmod, F.A., 1995. Acute and sub lethal exposure of catfish (*Clarias gaiepinus*) to cadmium chloride: Survival, behavioral and physiological responses. Pak. J. Zool., 27: 33-37.

Lakshmi, Sri. P. and R.Y. Probhakara, 2002. Evaluation of Cd toxicity on survival, accumulation and depuration in an intertidal gastropod. Turbo intercostalis. Water Air Soil Pollu., 134: 229-238

Liven, L. and A. Roony, 2003. Variations of organochloric residues with age and sex in Antractic minke whales Sci. Environ., 154: 179-200.

May, T.W. and G.L. Mekinney, 1981. Cd, Pb, Hg, As, and Se concentration in fresh fish pestic. Monit. J. 15: 14-38

Ogindo, B.A., 2001. Heavy metal pollutants and their concentrations in fish (*Barbus* species) in Sosiani River of Kenya. Discov. Innov., 13: 178-183.

Sinha, A.K., P. Dasgupta, S. Chakrabarty, G. Bhattacharyya and S. Bhattacharjee, 2002. Bioaccumulation of heavy metal in different organs of some of the common edible fishes of Kharkai River. Ind. J. Environ. Health, 44: 102-107

Swan, H.B., 1998. Aqueous phase ethylation atomic emission spectroscopy for the methyl mercury in fish using permeated dimethyl mercury calibration. Bull. Environ. Contam. Toxicol., 60: 511-518

Tam, S.Y. and C.S. Mok, 1991. Metallic contamination in oyster and other seafood in Hong Kong. Food Addit. Contam., 8: 333-342

Vos, G., J.P. Hovens and P. Hagel, 1986. Cr, Ni, Cu and Zn, As, Se, Cd, Hg and Pb in Dutch fishery products. Sci. Total Environ., 52: 25-40.

Villanueva, F.S. and A.V. Botello, 1998. Metal pollution in coastal area of Mexico. Rev. Environ. Toxicaol., 157: 53-94.

Yuka, E., N. Hunag and F. Youshimura, 2001. The distribution of trace elements in tissues of fish living in acid environments of national Yangminshan national Park. Taiwan. Anal. Sci., 17: 813.

Zyadah, M. and A.A. Chouikhi, 1999. Heavy metal accumulation in *Mullus barbatus. Merluccius mrrluccius* and *Boop bop* fish from the Agean Sea. Turkey. J. Food Sci. Nutr., 50: 429-434.