Lead Pollution in Fish

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Abstract: Cadmium and lead are non-essential and toxic metals which are distributed and released into the aquatic environment by industrial sources such as mining, refining of ores (Handy, 1994), plating process, the use of phosphate fertilizers and gasoline containing lead that leaks from fishery boats). Also, heavy metals (include Cd and Pb) enter the aquatic environment naturally from the rocks and soils directly exposed to surface water. These two metals (Cd and Pb) are concentrated from the water and sediments to the different parts of aquatic organisms including fish especially those exposed to the water. So, fish might prove a better media than water for detecting heavy metals contamination of freshwater ecosystem Because many fishes stay in rather confined regions of the river, they will suffer by one way or another if this aquatic system is contaminated by toxic substances, the fish will take those toxic substances through gills and skin and also orally with food.

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Introduction:

Pollution of river (water, sediment and fish) by Cd and Pb and other heavy metals has attracted attention for a considerable time. Cd and Pb in fish and shell fish has been studied (Kuroshima, 1987; Kareleeson-Norrgent et al., 1985; Mohamed, 1990; Handy, 1994; Zaky, 1995).

The use of Tilapia as a bio-assay organism for sensitivity to toxic effects may be appropriate relative for scale formation (Patin, 1984). Marine bivalves are often used as biological indicators for monitoring marine pollution with trace elements (Ishii et al., 1985). Cadmium, chromium and lead were studied in aquatic organisms in which the levels of these metals differs from one organism to another (Medina, 1986).

Cadmium and lead were determined in different parts of fish. Cadmium levels in various tissues of fish (kidney, gill, hepatopancreas) show the highest level in kidney than gill (Ikeda et al., 1986). Cadmium is observed to be present in higher concentration than Pb in muscle and liver of some marine invertebrates (Ishii et al., 1985). Studies of the accumulation and distribution of Cd in fish have shown that gill is one of the primary target organs of fish (Kumada et al., 1980). Cadmium accumulation in Girella Punctuate during a long term exposure shows that a large amount of Cd was accumulated in the livers and kidneys, followed by lesser amount in gills and intestines (Kuroshima, 1987). Concentration of Cd, Cu, Ag and Zn in fish liver increased in the agricultural areas in the River Basin, U.S.A. (Heing et al., 1997).

Several studies has been carried out in fish pollution by Cd and Pb in Egypt especially those (Tilapia nilotica) fish of the River Nile (Awadalla et al., 1985; Mohamed et al., 1990; Amal, 1993; Khallaf et al., 1994; Feshwi, 1994; Zaky, 1995).

The High Dam Lake (Nasser lake) (Figure 1), which is one of the largest man made lakes in the world, is the reservoir created as a result of the construction of High Dam in the south of Egypt.

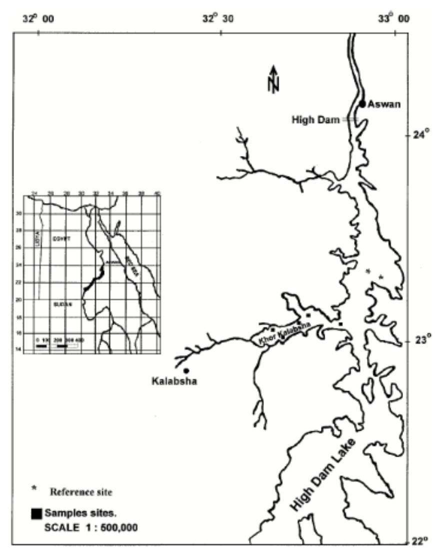

Figure 1. Map showing the sampling location in Khor Kalabsha at High Dam Lake.

There are no studies about the pollution of the High Dam Lake fish (Tillapia nilotica) with Cd and Pb. So this study was conducted to assess the Cd and Pb pollution in the fish and to detect the Lake water pollution through the accumulation of fish scales and the other tissues with Cd and Pb.

The present study is a part of a comprehensive program planned for environmental studies and assessments of trace and toxic elements in the ecosystem of the High Dam Lake. This study included water, fish, sediment and mud, as well as medicinal plants, wild plants, crops, soil and milk of some animals in the area near.

The input of heavy metals into the environment, whether terrestrial or aquatic, represents an important chapter in environmental pollution. Lead has been delineated as a hazard to public health, both from respiration and from ingestion, by the US Environmental Protection Agency (Engel et al., 1971). Except in aquatic environments, lead is rarely encountered in the ionic form. Somewhat less than 10~ of ingested lead is absorbed from the intestinal tract by man. About 90 ~ of the human body pool of lead is found in the skeleton, although all the organs contain some.

The fact that deleterious effects are known for man as well as for other organisms (Smith, 1970; Engel et al., 1971; Biesinger & Christensen, 1972) makes it essential that biological investigations take into consideration the protection of both man and his environment. In view of this necessity, experimental studies with lead assumed a twofold purpose. The first was to learn about its accumulation and distribution in an edible fish; the second was to see if a change in water pH significantly altered lead accumulation. Theoretical calculations of free Pb ÷÷ in water with a mineral composition similar to that of Lake Maggiore, ignoring the effect of organic ligands, show that it is about 13 times higher at pH 6.0 than at pH 7.5 (Baudouin & Scoppa, 1974). In addition, the tendency of ionic lead to be more abundant at low pHs in natural water has been reported by Davies & Everhart (1973), Moore (1973) and Smith (1973). Therefore, an increase in the concentration factors for lead at pH 6.0 would indicate that lead in the ionic state (as Pb ÷ +) enhances the ability of fish to concentrate it from water. The fact that PbHCO 3 +, another ionic form, is also involved cannot be ignored since it follows the same theoretical distribution as Pb *÷ (Baudouin & Scoppa, 1974).

The National Contaminant Biomonitoring Program (NCBP) is maintained by the U.S. Fish and Wildlife Service (FWS) to document temporal and geographic trends in concentrations of persistent environmental contaminants that may threaten fish and wildlife. The NCBP also provides information on the success of regulatory actions intended to reduce environmental concentrations of toxic materials. The NCBP originated in 1967 as the FWS segment of the National Pesticide Monitoring Program, a multi-agency monitoring effort by the member agencies of the Federal Committee on Pest Control (Johnson et af. 1967). During 1967-84, FWS has periodically determined concentrations of potentially toxic elements and selected organochlorine chemicals in samples of fish and wildlife collected from nationwide networks of stations. The results for organochlorine chemical residues and elemental contaminants in freshwater fish collected in 1967-81 have already been reported (Henderson et al. 1969, 1971, 1972; Lowe et al. 1985; May and McKinney 1981; Schmitt et al. 1981, 1983, 1985; Walsh et al. 1977). Analytical results are presented here for concentrations of arsenic, cadmium, copper, lead, mercury, selenium and zinc in freshwater fish collected in 1984 and early 1985 (here termed 1984), and temporal and geographic trends are evaluated by comparison with earlier findings.

Common carp (Cyprinus carpio L.), rainbow trout (Oncorhynchus mykiss Walbaum), and Siberian surgeon (Acipenser baeri Brandt) are cosmopolitan species found as native or introduced species in rivers of Europe, North America, and Northern Asia. The aquatic environment is characterized by marked temporal and spatial heterogeneity in the oxygen content due to water features such as temperature, salinity, and flows [. LUSHCHAK V. I., BAGNYUKOVA T. V. 2005, 2006,]. Therefore, aquatic organisms are exposed to oxygen levels with daily and seasonal variation.

Various metals can be introduced to the natural environment through human activity.

These metals pollute aquatic and terrestrial ecosystems, adversely affecting the environment and inhabiting organisms.

High concentrations of metals in fish tissues can lead to redox reactions, generating free radicals, especially reactive oxygen species (ROS), e.g. singlet oxygen; superoxides; peroxides; hydroxyl radical; and hypochlorous acid [DAUTREMEPUITS C., et al, 2002]. These highly reactive compounds, molecules, or ions formed by the incomplete one-electron reduction of oxygen, may induce alterations and change some physiological responses of fish [PARIS-PALACIOS S., et al 2000, VARANKA Z., et al 2001].

Oxygen is essential for many metabolic processes that are vital to aerobic life. However, dependence on oxygen forces aerobic life to withstand its considerable toxicity, as increased ROS levels can result in significant damage to cell structures [AHMAD I., et al 2004, AHMAD I., et al 2000]. ROS and other pro-oxidants are continually detoxified and removed in cells by an antioxidant defensive system comprising both antioxidant enzymes (SOD, GSSG, CAT, GPx) and small molecular weight free radical scavengers.

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