IMPACT OF HAZARDOUS EXPOSURE TO METALS IN THE NILE AND DELTA LAKES ON THE CATFISH, CLARIAS LAZERA

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Abstract. The impact of metal pollution in the Nile and Delta lakes was studied in *Clarias lazera*. Lake Edku is grouped as the site highest in metal concentrations. Compared to Lakes Maryût and Edku, the Nile stations displayed lower levels of metal contamination signifying their selection as *reference* sites. Metals were accumulated most by the liver, less by muscles and least by serum. Iron showed the highest bioconcentration factors (*BCF*) in liver, muscles or serum compared to other metals. Even after the refinement of the surrounding water, fish seem to uphold the metals that have been previously ingested. Mercury, in particular, seems to eventually reside in muscles rather than in liver. The positive relationship between total serum protein and metal contents may indicate the formation of specific metal-binding proteins. Meanwhile, serum hyperalbuminemia in polluted fish is probably a shock response towards the high stress index induced by metals. The hypothesis that most of serum copper is bound to ceruloplasmin is documented also in *C. lazera*. Moderate, but not extennsive, exposure to metals was quite stimulatory to liver alkaline phosphatase (AP) biosynthesis. AP could, thus, be considered as a promising *bioindicator* for assessing sublethal water intoxicosis.

Key words: alkaline phosphatase, catfish, ceruloplasmin, Delta lakes, metal residue accumulation, Nile, serum proteins

1. Introduction

The seas, rivers and lakes are the eventual sinks for many of the harmful or waste substances disposed by man. Aquatic life, including food fish, is capable of absorbing and concentrating these pollutants. In the meantime, the physicochemical properties of water are extensively modified. As a result, fish are exposed to frequent stresses.

The northern Egyptian Delta lakes are not an exception. They customarily act as temporary reservoirs for huge amounts of drainage water that is, often heavily contaminated with variable amounts of anthropogenic inputs. In addition, large loads of industrial wastes are dumped directly into the lakes. This is true, particularly for Lake Maryût, and to a lesser extent Lake Edku (Saad, 1988). Both lakes belong to an assembly of four shallow-brackish water lakes fringing the Nile Delta; the fishery in both of them is highly productive (Saad, 1988).

Exposure assessment of environmental pollutants is rather complicated because of the wide variety of unrelated chemicals. According to Jqrgensen and Johnson (1989), heavy metals are considered as the main causes of pollution in aquatic ecosystems and are expected to be so in the future, having the highest environmental

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stress index, often in excess of the recommended theshold limit values. Moreover, heavy metals are cumulative poisons that cause injury to animal organisms through their progressive and irreversible accumulation in animal organs and tissues when small amount of these metals are repeatedly ingested (McKim et al., 1976). This study, therefore, employed a spectrum of heavy metals (copper, Cu; iron, Fe; zinc, Zn; mercury, Hg; chromium, Cr) that are thought to have a significant stress index to fish.

The adverse impact of heavy metal shot on wildlife, particularly fish, is well documented and problems have been demonstrated in several species. However, less attention has been paid to the importance of the physiological condition of the fish itself and its ability to regulate and counteract the effects of exogenous toxicants (Segner, 1987). The freshwater catfish, *Clarias lazera*, an economically important fish species in Egypt, is widely distributed in most water areas, even in brackish waters or almost dry pools.

In fish toxicology studies, the interpretations about the function of alkaline phosphatase (AP) are rather contradictory (Ozretic and Krajnovic-Ozretic, 1993). However, when no serious tissue damage occurred, AP is more useful than some other specific enzymes in assessing sublethal effects of fish intoxication (Roberts et al., 179; Sauer, 1980). Ceruloplasmin is an α_2-globulin that exhibits an oxidase activity; although its significance is not quite clear (Murray et al., 1990). In addition, ceruloplasmin is a Cu-binding plasma protein that is believed to function as a ferroxidase during Fe metabolism (Martin et al., 1981). The main function of ceruloplasmin is the transport and donation of Cu. Also, it is an acute phase reactant with possible antioxidant and protective roles (Cousins, 1985). However, the interrelationship between intoxication with Cu and ceruloplasmin activity has not yet been extensively studied.

Serum electrophoretic protein profile is a fairly labile biochemical system that reflects precisely the physiological condition of the organism (Murray et al., 1990). Significant changes in the patterns of various serum proteins have been detected in several animal species that are subjected to lethal and sublethal levels of heavy metals (Fujiya, 1961; Thruston, 1967; Adham, 1992; Hussain, 1992; Lachapelle et al., 1993).

The object of this study is to contribute to the aspect of the interrelationship between the fish and its environment. This has been achieved through (i) comparing metal (Cu, Fe, Zn, Hg & Cr) concentrations in the water of the five selected locations, (ii) examining the concentration of each metal in fish muscles, liver and blood serum, (iii) calculating the bioconcentration factors (*BCF*) as a measure of metal availability in water to the fish, (iv) tracing the changes occurring in the concentrations and activities of some enzymes and biochemical constituents such as *total serum protein* and its *fractions*, liver *alkaline phosphatase* and serum *ceruloplasmin*.