Research Paper

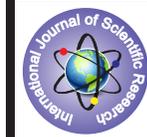# Bioaccumulation of Heavy Metal Pollutants in the Scales of A Freshwater Fish, Catla Catla From Harike Wetland, India

Zoology

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ABSTRACT Sustainability of wetland ecosystems is necessary for various important functions such as food storage, water quality continuation and providing habitat for different species of flora and fauna. This study has been carried out to delineate the change in the water quality of Harike wetland (Ramsar site) of Punjab, India. Observations show that the wetland is facing both natural as well as anthropogenic threats. Rapid urbanization, illegal settlements, industries, invasive species are the major cause of pollution in this wetland. Heavy metal pollutants has been detected in the scales of fish Catla catla through energy dispersive X-ray microanalysis technique which indicates the altered water quality because the elemental composition of the scale is directly related to the hydrochemistry of the wetland water in which the fish inhabits.

Introduction

With the growth of civilization, an increasing number of chemicals are being introduced to our environment. These chemicals are hazardous to living organisms, to humans and to our ecosystems. The aquatic environment is particularly sensitive to the toxic effects of contaminants since a considerable amount of the chemicals used in industry, urbanization and in agriculture enter marine and other aquatic ecosystems. Heavy metal contaminants have been reported in aquatic organisms. These pollutants build up in the food chain and are responsible for adverse effects and death in the aquatic organisms (Adham et al. 2002, Farkas et al. 2002, Olojo et al. 2005).

The fish, as a bioindicator species, plays an increasingly important role in the monitoring of water pollution because it responds with great sensitivity to changes in the aquatic environment (Mondon *et al.* 2001).

Catla catla is one of the most common freshwater and commercially important fish in Harike wetland. Fish scales are the first target of waterborne pollutants due to the constant contact with the external environment. It is well known that changes in fish scales are among the most commonly recognized responses to environmental pollutants (Johal et al. 1994, Johal and Dua, 1994).

Subsequently this study was planned to investigate the capability of metal pollutants to induce changes in the elemental composition of the scales of fishes.

Materials and Methods

The scales of fish were removed with the help of forceps from the second row above the lateral line and below the dorsal fin on the spot from the collection site. The scales were cleaned with distilled water and mucous left on the scale is completely removed.

The quantitative analysis of the various elements presents in the scale of the control as well as affected fish was observed by using the energy dispersive X-ray microanalysis (EDX) technique. The elemental composition was determined by placing the scanner of "INCAx-act analyzer" on the area of interest on the scale. This scanner was attached to JEOL JSM-6610LV scanning electron microscope. The X-ray spectrum from the specimen was then processed and analyzed to calculate the composition of different elements in the scale sample. The quantitative results were obtained by extracting the net peak intensities.

Results

Elemental composition of the normal scale of Catla catla or control fish

The elemental composition of the scales is directly related to the composition of water of aquatic body in which the fish inhabits. Keeping this fact in mind, the EDX of the normal scale of fish has indicated that there are four elements detected in the elemental composition of the scale (Fig.1) viz. Calcium(Ca-40.15%), oxygen(O-35.93%), Phosphorus(P-22.98%) and Magnesium (Mg-0.94%). Amongst these elements, Ca comprises the maximum percentage while Mg forms the least of the elements recorded in the scale.
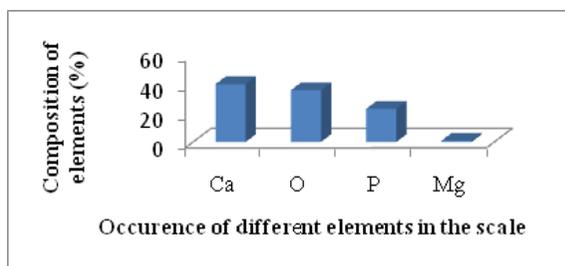

Fig.1: Elemental composition in the normal scale of Catla catla

Elemental composition of affected scale of Catla catla

The elemental composition of the scale of fish from Harike wetland has been altered due to the effect of pollutants. Various heavy metals were recorded in the composition of scale viz. Calcium (Ca-33%), Phosphorus (P-22%), Oxygen (O-39.29%), Aluminium (Al-0.15%), Magnesium (Mg-0.77%), Sulphur (S-0.04%), Chromium (Cr-0.64%), Silicon (Si-0.44%), Iron(Fe-0.32%), Nickel (Ni-2.3%), Copper (Cu-0.49%) and Lead (Pb-0.56%). The percentage composition of all the elements in the anterior part of the scale has been given in. Major elements in the composition of scale are Ca, P, and O whereas Si, Cr, S, Al, Fe, Ni, Cu, Mg and Pb make a small percentage (Fig.2).

The occurrence of all these elements in the scale composition clearly announces the presence of pollution in the wetland water which degraded the quality of water. As already pointed out that the nature of elements and their percentage composition has direct relation to the chemicals present in water in which the fish abode. The increasing pollution in Harike wetland affects the biodiversity of wetland. The bioaccumulation of heavy metals in the body of fish is a serious concern. It can affect the life of migratory birds as well as human being which are feeding on them.
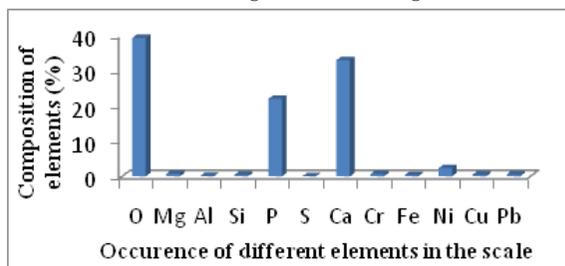

Fig.2: Elemental composition in the affected scale of Catla catla

Fish are often at the top of aquatic food chain and may concentrate large amounts of some metals from the water (Mansour and Sidky, 2002). The toxic effect and bioaccumulation of heavy metals have been reviewed (Aucoin *et al.* 1999, Adami *et al.* 2002, Waqar, 2006, Hayat *et al.* 2007). High concentration of metals in water can retard fish development causing possible alterations in fish size (Heath, 1987, Weis and Weis, 1989).

Concentration and bioaccumulation of metals in fish can be considered as an index of metal pollution in the aquatic bodies (Karadede-Akin and Unlu, 2007, Brraich and Jangu, 2012) that could be a useful tool to study the biological role of metals present at higher concentrations in fish (Dural et al. 2007, Brraich and Jangu, 2013). Knowledge of heavy metal concentrations in fish is important with respect to aquatic environment health, wellbeing of aquatic wildlife and human consumption of fish.

Conclusion

The toxicological studies of scales employed by energy dispersive X-ray microanalysis (EDX) indicated that alterations in the elemental composition of the scales are excellent pollution indicator and announces pollution in the water of Harike wetland with authenticity.

Further study is needed to evaluate such trends on reproductive system of fish and much smaller aquatic species (i.e., early life stages of fish and other small benthic organisms).

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