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A HISTOPATHOLOGICAL STUDY ON THE FRESHWATER FISH: A REVIEW

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ABSTRACT:

The present study examined the gills and liver histopathology of the freshwater fish from different sites in the Son River. At Site A, the concentrations of some metals such as cadmium, aluminum, arsenic, lead, and manganese exceeded acceptable levels according to the Turkish Standards Institute. Moreover, the concentrations of metals in the liver and gills of the collected fish were determined. The presence of histological alterations was assessed by the degree of tissue change. The quantitative histological assessment indicated that the histological lesions were comparatively most severe in the liver. The results revealed that anthropogenic pollution of aquatic ecosystems affected the fish in their natural habitat.

KEY WORDS: *Fresh Water, Son River, histopathology gills and liver.*

INTRODUCTION

The pollution of aquatic ecosystems is a cosmopolitan problem that needs urgent attention and prevention. Since the aquatic environment is the ultimate recipient of pollutants, increased industrial, domestic, and agricultural activities have resulted in an increasing number of freshwater systems being impacted by the pollutants present in wastewater release. Agricultural, industrial, and domestic effluents generally contain heavy metals such as Cr and are, invariably, discharged into rivers and streams, without proper treatment. Due to their toxicity, long persistence, and bioaccumulative and nonbiodegradable properties in the natural environment, metals constitute a core group of aquatic pollutants (Authman, 2011). Heavy metals such as Cu, Pb, Zn, Cd, Mn, and Fe are predominant in water and sediment (Rajeshkumar and Munuswamy, 2011). In aquatic ecosystems, these metals are present throughout and are detectable in critical amounts. As a result, the widespread discharge of these pollution agents causes a serious threat to aquatic life. In aquatic ecosystems, fish are regarded as a valuable indicator of environmental pollution since they are at the top of the aquatic food chain and are known to accumulate toxicants (Authman et al., 2012). Histopathological investigation of fish tissue allows for early warning signs of disease and contributes to understanding of the nature of stress responses. The gills of freshwater fish are the first target organ of several xenobiotics because of their direct contact with the water (Perry and Laurent, 1993). Similarly, the liver is generally regarded as the central organ of xenobiotic metabolism in fish and alterations in liver structure may be useful as biomarkers that indicate prior exposure to environmental stressors (Van Dyk et al., 2012).

MATERIAL AND METHODS :

Study area:

Sidhi is located at24.42°N 81.88°E. It has an average elevation of 272 metres (892 feet) and covers a geographical area of 10,536 km². It is a state of Chandela Rajputs who came from Khajuraho. They mainly live in Bardi State and then again divide into a few areas in Sidhi. Son River is a perennial river located in central India. It originates near Amarkantak Hill in Annupur district of Madhya Pradesh and finally merges with the Ganges River near Patna in Bihar. Sone river is the second-largest southern tributary of the Ganges' after Yamuna River. India's oldest river bridge Koilwar Bridge over Sone River connects Arrah with Patna. Sone river is famous for its sand across country.

Analytical procedures:

Surface water samples were obtained from a depth of 0.5 m below the surface and transported to the laboratory at 4°C in clean plastic bottles and analyzed according to standard procedures (APHA, 1998) using a PerkinElmer model 306 atomic absorption spectrophotometer. Liver and gill samples were removed, rinsed with distilled water, and stored at –18°C prior to analysis. A temperature-controlled microwave heating device was used for digestion of the dried fish tissues. Sample preparation was carried out according to the procedure described by Uluozlu et al. (2007). Approximately 0.5-g homogenized samples were taken and 3 mL of ultrapure HNO_3 and 1 mL of hydrogen peroxide ($H_2 O_2$) were added to them for digestion.

Histopathological procedures:

Gill and liver samples were processed using a standard histological technique and stained with hematoxylin and eosin. From each fish 10 sections of each tissue were examined by light microscope and 20 fields per section of each tissue were observed.

RESULT AND DISCUSSION :

In aquatic ecosystems, there are various stressors that can be responsible for causing irritating reactions in fish. It seems possible to attribute the occurrence of a liver pathology to other pollutants since aquatic ecosystems receive diverse kinds of pollutants. There was no water treatment facility at Site A to reduce the metal concentrations to allowable limits. Thus, the results of the present study suggest a relationship between metal pollution and liver pathologies. Hepatic necrosis was correlated with arsenic, cadmium, and copper concentrations in water by Oliva et al. (2013). Kaur and Dua (2014) found observations similar to the present study like pyknotic nucleus, sinusoidal dilatation, and melanomacrophage centers in Channa punctatus exposed to wastewater. Melanomacrophage centers can occur in toxic conditions and point to increased heavy metal concentrations (Poleksic et al., 2010). Hypertrophy may be an adaptation of fish to meet the metabolic needs compromised by the nuclear degeneration caused by some xenobiotic chemical. Cellular and pancreatic degeneration and congestion in the liver of Poecilia vivipara caught in the Cachoeira River were noted by Paulo et al. (2012).

Histopathological disorders have been used as bioindicators to measure the health of showed following exposure to contaminants in both lab and field study. The gills of a fish are the most fragile part of its body. Their weak point is that they are subject to damage from any unpleasant substances, whether decomposed or floating in the water, because to their fantastic outdoor location and near to water. The current discovery highlighted the impact of edematous alternatives on non-compulsory lamellae motivation. In conventional fish gill histology regions, the major gill lamellae are horizontally arranged stage leaf-like designs arranged on one or both sides of the interbronchial barrier. There will be a line on each of the two facets across the broad hub of crucial gill lamella.

The essential gill lamella incorporates a focal middle in which the cartilaginous bar and veins lie. The non-compulsory lamella are profoundly vascularized and accordingly assigned as respiration lamella and encompassed by a mild layer of epithelial cells. The interlamellar location is between the 2 contiguous respiration lamellae. The progressions observed in the gills after brief pesticide exposures were hyperemia, clubbing, and edema.

Morphological alterations in the gills, particularly gill epithelium elevating and epithelial cell hyperplasia, expand the distance between the outer medium and the blood flow, posing a barrier to the uptake of undesirable chemicals (Raibeemol and Chitra, 2016). The gills of *Carassius auratus* treated with Chlorpyrifos showed similar changes (Macirella et al., 2019, and 2020). Gills have now become edematous with significant clubbing within a brief period of pesticide openness. It has been shown that essential gill lamellae partition and drain within the veins of non-compulsory gill lamellae. The presence of hyperemia in gill fibers distended in veins was confirmed. Hyperplasia resulted in the formation of non-compulsory gill lamellae that resulted in an accumulation of important and auxiliary gill fibers.

CONCLUSION:

Histopathological changes in the gills and liver observed microscopically showed increasing degrees of damage in the tissues in correlation with the contamination levels of the river. Industrial and domestic effluents may contain bulk quantities of toxic heavy metals such as Pb, Ni, Cr, Cu, Cd, and Zn (Aonhgusa and Gray, 2002; Manzoor et al., 2006). In our study, analysis of water samples revealed elevated levels of Cd, Al, As, Pb, and Mn in the downstream part of the Karasu River and the concentrations of the metals at Site A were higher than recommended by the TS 266 regulation. Target organs, such as the liver and gills, are metabolically active tissues that accumulate metals at higher levels, as previously reported in studies (Barson et al., 2014).

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