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Full Length Research Paper

Histopathological Changes in the Gill Tissue of the Fish *Catla catla Exposed* to Untreated and Treated Sago Effluent

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Abstract

Pollution of the aquatic environment is a serious and growing problem. Increasing number and amount of industrial, agricultural and commercial chemicals discharged in to the aquatic environment having led to various deleterious effects on the aquatic organisms. Aquatic organisms, including fish, accumulate pollutants directly from contaminate water and indirectly via the food chain. The study of histopathological effects of pollutants on the different organs of the fishes is an important basic effort leading to our understanding of true impact of pollutants on that ecosystem because the fresh water fish show dissimilar pattern of response when exposed to toxicants. In the present study the histopathological changes are observed in the gill tissue of the fresh water fish Catla catla exposed to 50% and 100% concentrations of untreated and 100% treated sago effluent. The histology of gill tissue showed various degrees of deterioration when compared to control. The deterioration was very much reduced in the treated sago effluent when compared to the untreated sago effluent.

Key words: *Catla catla, Sago effluent, histopathology, gill tissue, pollution*

Introduction

A thorough knowledge of normal histology is essential for the understanding of the altered structure seen in the various conditions of disease. Histology acts as an integrated parameter, providing a more complete evaluation of the organisms' health, effectively monitoring the effects of exposure to environmental pollutants (The *et al*., 1997; Van Der Oost *et al*., 2003). Fish are sensitive indicators of pollutants present in water. These pollutants cause various physical and physiological alterations in fishes (Trivedi *et al*., 2002).

Histopathological alterations can be used as indicators for the effects of various pollutants on organisms and are a reflection of the overall health of the entire population in the ecosystem. These histopathological biomarkers are closely related to other biomarkers of stress since many pollutants have to undergo metabolic activation in order to be able to provoke cellular changes in the affected organism (Fatma, 2009).

Sangalang and Freeman (1979) have suggested that fish gills could be used as a sensitive organ for testing the effect of chronic sub lethal exposure to toxicant. Weatherly *et al*. (1980) have suggested that gill and liver tissues appear to be the best tissue for analysis, if fish are to be used as bio monitors of pollution. Gills are the most sensitive and the susceptible organ, which gives the entry to heavy metal easily from ambient water than via skin and food for the accumulation in the fish (Holcombe *et al*., 1976; Hilmy *et al*., 1987). The fish easily gets the tissue damaged due to water pollutants. Gills are one of the vital organs, which come into direct contact with water and are indicative of any environmental stress (Ramesh and Nagarajan, 2007). Hence, the present study has been undertaken to examine the effect of sago effluent on the gill tissue of the fresh water fish *Catla catla.*

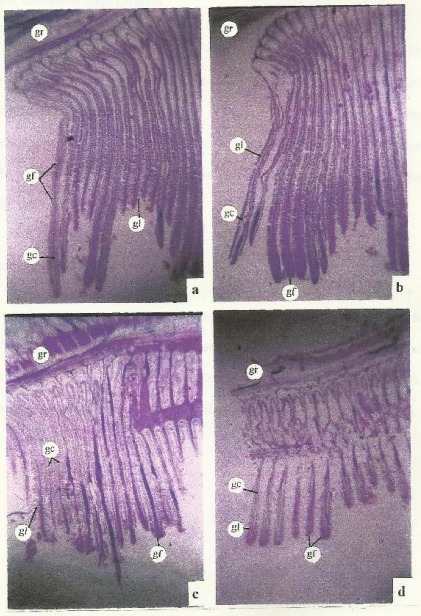
Materials and Methods

Fingerlings of healthy *Catla catla* procured from SIRAGO Aqua Agri farm, Neringipettai of Erode District, Tamilnadu, India and were brought to the laboratory and acclimatized for 15 days. The fish were well fed during the acclimatized period. Feeding was stopped one day before commencement of the experiment. The test individuals were killed by narcotization method. Gill tissues were cut from the fishes and the histological studies were done using standard microtechniques.

Results

Control

In the control group the gill filaments show normal structure. They have a large number of small secondary lamellae which project up from its upper surface and down from its lower one. The adjacent gill filaments touch each other at their distal ends (Fig.1).



(gr- gill rakers, gf- gill filaments, gc- gill capillaries, gl- gill lamella)

Fig.1. Histology of gill tissue of *Catla catla* exposed to a) Control b) 100% treated sago effluent and c) 50% d) 100% untreated sago effluent.

100% Treated Sago Effluent

In this group no marked changes is observed. However the gill filaments at the distal ends have shown some deterioration. They are detached from other gill filaments and that means the efficiency of the gases exchange would be reduced to a certain extent.

50% Untreated Sago Effluent

The individuals exposed to 50% concentration of untreated sago effluent show further deterioration in the gill lamellae. Quite a few lamellae showed marked erosion from their distal ends. The arrangement of the secondary lamellae has also been disturbed. In several areas the secondary lamellae have disappeared, which means a considerable reduction in the efficiency of oxygen exchange.

100% Untreated Sago Effluent

A severe damage has been inflicted on the gills in the 100% untreated sago effluent exposed individuals. The gill lamellae are broken in several places and so are the secondary lamellae. A serious damage is seen in the gill arch also. There is a severe damage in the vascularization in the lamellae.

Discussion

In the present investigation, the gill exposed to untreated effluent exhibited marked histopathological changes when compared to treated effluent. The severity increased with higher concentration of effluent. The individuals exposed to different concentrations of untreated and treated sago effluents have shown extensive damages in their gill filaments and secondary lamellae. Similar observations were made by Aruna (2003) in the fish *Labeo rohita* reared in distillery effluent and Shanthi (2003) in the *Catla catla* exposed to tannery effluent. Nagarajan, and Bhuvaneswari, (2009) have studied the Histopathology of *Clarias batrachus* exposed to untreated and polyelectrolyte treated tannery effluent.

Ramesh and Nagarajan (2007) have noticed that the fish *Clarias batrachus* exposed to different concentrations of untreated and treated sago effluents have shown disintegration of primary and secondary gill lamellae, gill epithelium, gill capillaries and gill filaments. Nagarajan and Shasikumar (2002) have investigated the effect of sago effluent in the fish *Labeo rohita*. The results have shown that some degeneration in the capillaries of gills and slight changes were seen in the gill lamella.

Erkemen *et al*. (2000) have studied the histopathological effects of *Lesbistes reticulates*. The results show cyphenothrin lifts the epithelial layer from gill lamella due to edema and shortening of secondary lamellae. Bhatnagar *et al*. (1992) have observed the erosion and disturbance in the basement membrane, degeneration of gill lamella, space formation, vacuolization, necrosis, clumping of blood cells and development of lacunae in the secondary gill lamella in the fish *Clarias batrachus* exposed to lethal and sublethal concentrations of endosulfan. Similar observations were made by Dhanapakiam *et al*. (1998) in the fish *Cyprinus carpio* exposed to cadmium and mercury.

Ribelles *et al*. (1995) studied the biological effects of sodium dodecyl sulphate in the gill tissue of Giltheads (*Sparus aurata L*). Serious morphological damage to the gill structure has been reported. Distention of gill plates, vacuolation and necrosis of gill tissues with extensive hyperplasia were observed in fish exposed to tannery effluent. But in the case of fish exposed to textile mill effluent, the mucus cells showed hypertrophy while blood capillaries were shrunken (Sakthivel, 1994). Roy and Munshi (1991) have reported the rupture in the tip of the primary lamella of *Cirrhinus mrigala*. Fusion and thickening of gill lamellae, increased production of mucus was observed in the fish *Channa punctatus* exposed to copper and mercury (Singh and Datta, 1996). Ramalingam and Murabai (2002) have studied toxicity of chlorine and its sub lethal effects on tissue histology of *Oreochromis mossambicus*. The gills demonstrated mucus elaborations, epithelial lifting and inter lamellar cell debris formation.

Conclusion

The above findings and the results of the present study indicate that the gill is a sensitive tissue gets affected easily by the pollutants. The gill tissue treated with untreated effluent exhibited marked histopathological changes when compared to treated effluent. The severity increased with higher concentrations of effluent. So the untreated effluent has more effect on fish *Catla catla* than the treated effluent.

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