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BARIUM CHLORIDE IMPACT ON GILL ARCHITECTURE OF FISH, *CHANNA PUNCTATUS* (BLOCH)

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ABSTRACT: - In developing countries like India, the amounts of pollutions in the aquatic environment have been increased by the industrial activities. Toxic pollutants including heavy metals are polluted aquatic environment. Fishes are mostly sensitive to changes in their surrounding environment. Among heavy metal pollutants, it is non-essential, noncorrosive in nature and highly toxic metal. Barium chloride does not breakdown in the environment and can bio-accumulate for many years after exposure to low levels of this metal. Fish may absorb metal directly from contaminated water or indirectly from feeding on living organisms in the contaminated water (Javed, 2005). Several studies show their bioaccumulation in different fish tissues viz, skin, gill, muscle, brain, liver, kidney, intestine, gonads etc (Vinodini and Narayanan, 2008). The toxic pollutant affects water quality and feeding, swimming behavior of fish and also delays the hatching, maturation period (Atif et al. 2005). In this peace of research the toxic effect of Barium Chloride on the architecture of gill of the fresh water, edible fish, *Channa punctatus* (Bloch) affects its histopathology after the exposure period of 10 days, 20 days and 30 days.

KEYWORDS: *Channa punctatus*, Barium Chloride, Gill**.**

INTRODUCTION

The snakehead air breathing fishes, *Channa punctatus*, are exclusively fresh water with a wide distribution and found as a valuable food fish. This fish is a useful bio-indicator organism of heavy metal contamination of water (Singh and Goswami 2010).The main objective of this study was to determine the lethal concentration LC_{50} of barium chloride compounds at 24 hr.(instant toxicity) and the behavioral and morphological alterations due to action of toxicant on snakeheaded, fresh water- air breathing fish *Channa punctatus*.

Water pollution is a major problem of this century owing to the addition of various pollutants in water bodies through many ways and they change their natural qualities of water. In case of inland water contamination pesticides are known commonly, closer to areas of their applications which affect growth, reproduction and nutritional value of fish, when their concentration in water exceeds the critical maximum limit. Among different classes of pesticide organophosphate are more frequently used, because of their high insecticidal property, low mammalian toxicity, less persistence and rapid biodegradability in the environment.

Alterations in the cellular morphology of pesticide treated fish and their physiological functions upon exposure to different pesticide concentrations have been observed by Gupta and Saxena. The investigation of histopathology of various organs may therefore, prove it is cost effective tool to determine health of fish population and reflecting the health of entire aquatic ecosystem.

The study of fish gills are among all the most sensitive organ, which reacts first in changed environment. Since respiration, osmoregulation and are performed through the gills. The ecological effects of pollutants in aquatic ecosystems and their bioavailability and toxicity are closely related to species distribution, both in the solid and the liquid phase of the aquatic ecosystem. (Ilavazhahan et al. 2010). The poisoning by pesticides from agricultural fields is a serious water pollution problem and its environmental long-term effect may result in the incidence of poisoning of fish and other aquatic life forms. Chronic exposure and accumulation of these xenobiotics by aquatic biota can result in biochemical and tissue burdens that produce adverse effects not only in the exposed organisms but also in human beings. It seems essential to study the lethal toxicity and stress of such environmental pollutants so as to formulate the strategies for safeguarding aquatic organisms (Nwani et al. 2010).

Fishes are very sensitive to a wide variety of toxicants in water; various species of fish show uptake and accumulation of many contaminants or toxicants such as pesticides. Accumulation of pesticides in tissues produces many physiological and biochemical changes in the fishes and freshwater fauna by influencing the activities of several enzymes and metabolites.

In aquatic toxicology LC_{50} may be defined as the concentration of a compound that causes lethality of 50% of the exposed individuals. Fish serves as a bio-indicator species as it responds with great sensitivity to changes in the aquatic environment and thus, has an

important role in the monitoring of water pollution (Srivastava et al. 2010).

The bioaccumulation of toxic metals can occur in the body and food chain. So, the toxic metals generally exhibit chronic toxicity. For example, the radioactive heavy metals like radium can imitate calcium (Ca) to be incorporated into the bone, but the similar health hazards can also be due to Pb or Hg. However, barium (Ba) and aluminum (Al) are exceptions as they can be quickly excreted by the kidney, liver and gills.

MATERIALS AND METHODS

Live specimens of fresh water fish, *Channa panctatus* (Bloch).were selected for the present research work. The fish were produced for the experimental purposes from the fresh water Adan dam of Karanja lad, Dist. Washim, (M.S). This fish were brought to the laboratory in well oxygenated bag without any injury. They were washed with 1% KMnO4 solution for 5 min. for dermal disinfections.

The fishes were allowed to acclimatize in the laboratory conditions. For a period of fourth night before conducing the experiment. Particularly in the morning hour fish fed on small pieces of boiled eggs ones in a days. The total eight fishes including experimental works. They were maintained in separated aquarium containing edge tap water.

Test Toxicants:-The Barium chloride was selected as toxicant for the present investigation. The physiochemical properties of **$BaCl_2$** are as below.

1) Chemical name: 3-iodo-N,phthalamide(2-mesyl-1,1-dimethyl ethyl tetrafluromethyl)ethyl]-O-tolyl)-N-{4-[1,2,2,2-tetrafluro-1]} phthalamide
2) Molecular Formula: BaCl2
3) Molecular Weight: 208.23 g/mol.
4) Appearance :White Color crystal
5) Odour: No characteristic odour
6) Melting point : 963^0C
7) Boiling point:1.560^oC (760.00mmHg)
8) Density (At20.8^0C) :1.659 g/cm^3

After 10,20 and 30 days the male and female fish of control as well as experiment set were sacrificed immediately by given below on the head and were di. Thus the tissue of gill dissects out and rinsed saline to remove cell-debris and blood stains. Then the tissue, gills was cut into small pieces of desirable size and fixed in to aqueous Bouins fluid. All possible precaution were taken to insure to proper fixation of the tissue.

Toxicant Studies

To study the effect of barium chloride i.e. BaCl2on various organ. The experiment were conducted in two aquaria. The lethal concentration and sub lethal concentration of the experimental toxicant i.e. BaCl2 were collected from the literature. In first set for the control set while the second set in referred as experimental set.

In each set total four fish is taken for the purpose of the experiment. The static bioassays were carry out as per standard method, (APHA 1986) Aqueous solution of the toxicant was added drop by drop with constant stirring and then an acclimatized four fish were transfer to the glass aquarium containing 30 lit of toxicant water in set 2. Simultaneously set 1 containing normal or control fish. The fish were fed with small pieces of boiled eggs, once in day especially in morning hour. Observations were made for 24 hour in experimental set. The time at which the fish losses it sense of balance was noted, keeping these observation in mine for the final experiment. Fish also shows erratic movement. The experiment were carried out in sub lethal concentration of toxicant BaCl2 (0.07 mg/lit) for a period 10 days, 20 days, and 30 days. Both the set of control and experiment were run simultaneously in separate aquarium.

Histopathological Studies

After fixation the tissue, gill tissue thoroughly under the running water for three hours. Then they were dehydrated and embedded in paraffin wax as per the regular procedure. The section of the gill was cut at 5µ thickness and was stained with haematoxylene-eosin.

OBSERVATION

In the present peace of work the freshwater , air breathing fish *Channa punctatus* (Bloch) shows the normal or control structure of gill architecture are as follows-

Histopathological observations of gills –

The gill is composed of numerous gill filaments which have two rows, primary gill lamellae and secondary gill lamellae that run perpendicular to each filament. The lamellae are lined by a squamous epithelium composed of pavement and non-differentiated epithelial cells. Each lamellae made up of two sheets epithelium delimited by many piller cells which are contractile and separated the blood capillary (channels) in which one or two erythrocytes are usually recognized within each capillary lumen. Between the lamellae and filament is lined by a thick stratified epithelium constituted by several cellular types such as chloride cells and mucous or globate cell and pavement cells. (Fig. 1).

Fig. 1 : T.S. Through the Gills of fish, *Channa punctatus* (Control). Hematoxylin-eosin, x630

Experimental Changes in the Histopathological Structure of Gills -;

In the present study, a variety of histopathological changes were observed in the gill architecture of *Channa punctatus* (Bloch),when treated with experimental toxicant Barium Chloride, having sublethal concentration 0.07 mg/lit, the frequency of organ lesions was found to be more pronounced in fish treated with Barium Chloride.

The experimental freshwater, air-breathing fish, *Channa punctatus* (Bloch), exposed to experimental toxicant sublethal concentration 0.07 mg/lit of Barium Chloride for the period of 10 days . T.S. of gill showed some signs of epithelial lesions. The main changes observed at long term period like 10 days were accentuated lifting of lamellar epithelium (fig. 2).

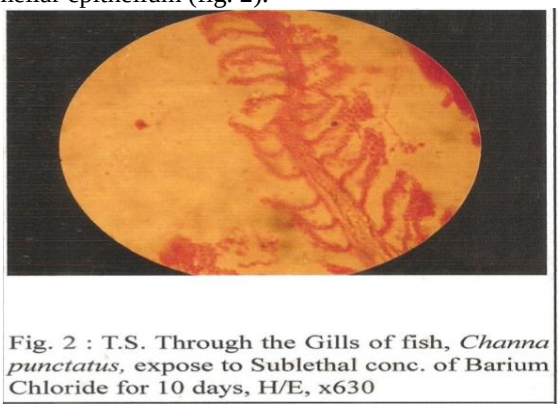

Fig. 2 : T.S. Through the Gills of fish, *Channa punctatus,* expose to Sublethal conc. of Barium Chloride for 10 days, H/E, x630

After 20 days exposure to the sublethal concentration 0.07 mg/lit of experimental toxicant, the T.S. of fish *Channa punctatus* showed Oedema in the filamentally epithelium and an intense lamellar vasodilatation , gill lamella fusion in numerous areas of secondary lamella (fig. 3).

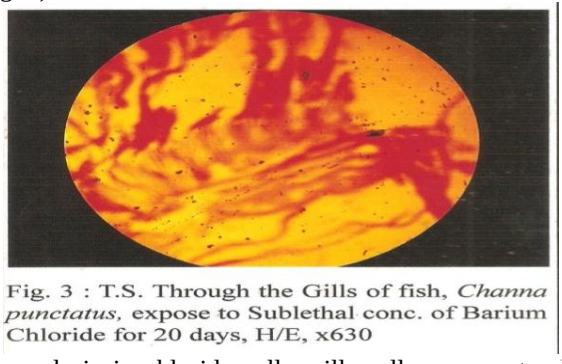

Fig. 3 : T.S. Through the Gills of fish, *Channa punctatus,* expose to Sublethal conc. of Barium Chloride for 20 days, H/E, x630

Hyperclesia in chloride cells, pillercell ,pavement cells and mucous secreting globate cells , gill showed lamellar aneurism (lesions of blood vessels), synechiae (adhesion of tips) and congestion and leucocytes infiltration, interlamillar oedema were noticed . When the experimental fish, *Channa punctatus* exposed to the sub lethal concentration of toxicant Barium Chloride for a period of 30 days(fig.4).

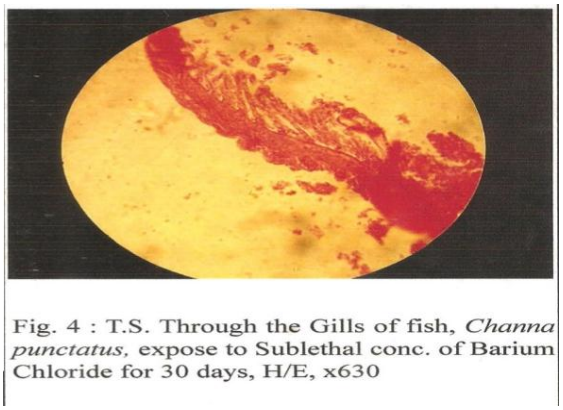

Fig. 4 : T.S. Through the Gills of fish, *Channa punctatus,* expose to Sublethal conc. of Barium Chloride for 30 days, H/E, x630

DICCUSSION

In the present study the histopathological changes observed in the respiratory organ, gill of fresh water fish *Channa punctatus*(Bloch) exposed to sublethal concentration of Barium Chloride were remarkably higher as compared to control/ normal fish . It may due to its more accumulation of toxicant in gills.

The separation of epithelium from underlined vascular layer has been reported in Barium Chloride toxicity in the present study. Similar result were reported by Gupta and Kumar(2006), mercury ions induced sever histopathological changes in gill such as degeneration in the middle and distal region in the primary lamellae. In the distal region spherical structure was formed due to degeneratioin and fusion in pillar , epithelial and mucus producting gland cells along with large number of blood cells of the secondary gill lamella .

Palipoch*et al.(* 2011) :state that hyperplasia of gill epithelium , epithelial lifting and lamellar fusion in gills cytoplasmic degeneration in hepatocytes , vacuolization of nucleus and irregular shapes of hepatocytes. In the present investigation mercury ions induced severe histopathological changes in gill such as degeneration in the middle and distal region in the primary lamellae. The pathological changes of large blood vessels caused by methoxychlor are described in bluegill .

Thus the result present investigation with Barium Chloride as a toxicant after treated with gill tissue is almost similar to those of the above investigators.

Tilak *et al* (2005), reported that Chlorpyrifos intoxication in fish, *Catla catla* caused dropsy, vascular degeneration, cloudy swelling, necrosis and other degenerative changes in epithelial and pillar cells of the gills.

Haematological and biochemical parameters are used as indicators in the measurement of health conditions and toxicological symptoms of organisms as reported by Venkateshwara Rao, (2006). Haematological and blood biochemical studies on textile effluent toxicity in the *Gaumbusia affinis* was carried out by Pariimal *et al.* (2006). The above references of the investigator showed

the similar changes in the architecture of gill after exposure to Barium Chloride up to 30 days.

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3. **Gupta and Saxena** :-According to Gupta and Suxena, alterations in the cellular morphology of pesticide treated fish and their physiological functions upon exposure to different pesticide concentration.
4. **Ilavazhahan et al. (2010)**:- stated that the ecological effects of pollutants in aquatic ecosystems and their bioavailability and toxicity are closely related to species distribution, both in the solid and the liquid phase of the aquatic ecosystem.
5. **Javed, (2005):-** According to Javed, fish may absorb metal directly from contaminated water or indirectly from feeding on living organisms in the contaminated water
6. **Palipoch *et al.* (2011)**: state that hyperplasia of gill epithelium, epithelial lifting and lamellar fusion in gills cytoplasmic degeneration in hepatocytes, vacuolization of nucleus and irregular shapes of hepatocytes.
7. **Primal *et al*. (2006)** was carried out Hematological and blood biochemical studies on textile effluent toxicity in *the Gaumbusia affinis*
8. **Singh and Goswami (2010):-**observed that the snakehead air breathing fishes, *Channa punctatus*, are exclusively fresh water with a wide distribution and found as a valuable food fish. This fish is a useful bio-indicator organism of heavy metal contamination of water.
9. **Srivastava et al. (2010)**:- According to Srivastava et al. ,Fish serves as a bio indicator species as it responds with great sensitivity to changes in the aquatic environment and thus, has an important role in the monitoring of water pollution.
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12. **Vinodini and Narayanan, (2008)**:- stated that several studies show their bioaccumulation in different fish tissues viz, skin, gill, muscle, brain, liver, kidney, intestine, gonads etc.