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Effect of fly Ash Pollution on Fish Scales

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Abstract

Fly ash is a major pollutant containing As ,Cd, Zn, Cr, Co, Pb and Hg .When this pollutant finds its way in water ,it is bound to effect the fauna living there. Thus, the fishes were studied to see the effect of fly ash on them. The scales are the outer most extremities and the first structural protective layer for fishes. Thus its effect on scales was selected for this study. The study was done on Tilapia (Oreochromis mossambica) for 6 month exposure. In this study the changes of ultra structure of fish scales were observed.

Keywords: Fly ash, pollutant, tilapia (oreochromis mossambica), ctenoid scales, structure.

Introduction

Fishes have various types of scales which enhances its protective nature, apart from mucous which is a secretion from skin. The scales are originated as an outgrowth of the dermis. This is covered by a mucus layer that is continually secreted by specialized mucus cell[1]. Fish integument system have evolved to protection against abrasion, ion loss, hydration, dehydration and pathogen invasion[2,3]. Fish skin and scales also possess of physiological and morphological function. Fish have been used for many years to determine the pollution status of water and are thus regarded as excellent biological marker in aquatic ecosystems[4, 5]. The increasing importans of fish as a source of protein and the interest in understanding the accumulation the heavy metals at the tropic levels of food chain extends the focus toward fish integument system (Fish skin). In general fly ash is by far the major by product from coal based power production. Coal ash is a common source of pollution all over the world along with India, in the U.S. sixty- three million tons of coal ash was produced in USA in 1984 and production increased by 75% by the year 2000. The trace element composition of fly ash from a single facility has, however been reported to very measurable on a daily basis[6] has been observed includes As, Zn, Cr, Co, Pb, and Hg[7]. The variable degree of these trace elements interferes in biologically essential and natural constituents of the aquatic ecosystems and become toxic only at different concentrations[8,9]. The toxic effect of heavy metal have been reviewed including bioaccumulation[10, 11]

The heavy metal pollution enters fish through different main via food or nonfood particles; these are gills, oral consumption of water and skin through absorption[12.] The main object of this study is to see the damage done to the fishes starting from their outermost protective layers; Skin and first most the scales because scales play an important role in the different patches. Scales- Fish scales play an important role in fishes for the supply of mineralized food, good body growth and protection of the body system at the adversely affect in the water body and in ichthyology for the purpose of identification, experiments and find the age and growth performance of fish body.

The present heavy metal constituents in fly ash water also affect the scale structure because it is a directly in contact with water. Heavy metals can also adversely affect the growth rate in major carps[13]. Scale of fish can accumulates high concentration of metal such as Zn, Pb, Mg, and Cr. Mucus secretion on the fish scale was effective in removing Pb and Hg from water but most of this sequencing was due to fish scales[14]. The first line of defense of fish against heavy metal lies in their epidermal mucus secretion. Fish secrete excessive amount of mucus when they come in contact with pollutant particles. The lubricating properties of mucus provide protection against inorganic particles and biological organisms while its constituents such as Pb, Cu and Zn can induce mucus secretion in various species of fish.

Materials and Method

Tilapia (Oreochromus mossambica) fish were collected from freshwater pond and placed in freshwater aquarium for acclimatization at 2 month after acclimatization the fishes were transferred in fly ash pollutant water for 6 month exposure. During 6 month study period we increased the fly ash quantities in the fresh water aquarium.

After 6 month study period the scales were taken for study from 4 different regions (Dorsal, Ventral and Operculum and tail region) of fish body. The Ultra structure of fish scales were studied and microscopic study was done.

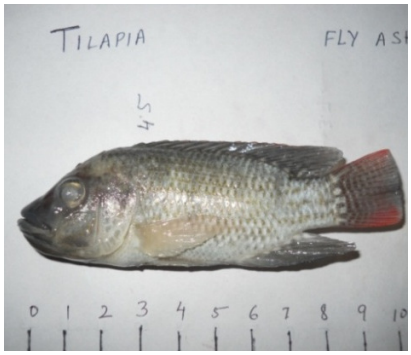


Figure – 1
6 month exposure fly ash Fish Tilapia
(Oreochromus mossambica)

Results and Discussions

Scales in normal condition: Tilapia (Oreochromus mossambica) species have ctenoid scales. These ctenoid scales are derived from the dermis. Scales are situated on the outer part of the body system. Which helps in protection is adverse condition in the water. The Ultra structure of scales in normal condition at the experimental period was taken from 4 different region (Dorsal, Ventral, Operculum, Tail region) on the fish body. The observation was as follows.

Controlled – Normal fishes: The anterior margins of scales are much fined and fully develop. The calcified bony ridges are arranged parallel and continually develop from focus to anterior margin. The circuli are arranged concentrically around a central circular zone called focus. They show well up on the embedded part of the scale and help in determining the exact age of the fish. They are finally placed. The zone of crowded and fine circuli is known as annuli. The growth of scales, annuli are increased and show the very clear for the counting of age of life. As well as the exposed part of scales on posterior margin i.e. origin part of dermis. They are arranged obliquely in a manner that the posterior end of one scale overlaps the anterior edge of the scale, present behind. The arrange alternative lines which become bony ridge is called Radii. This is differentiated into the bony ridges at the normal condition.

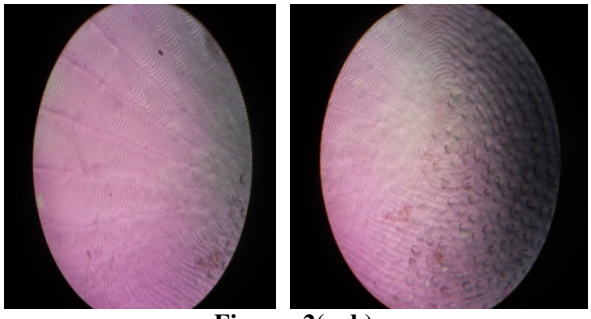
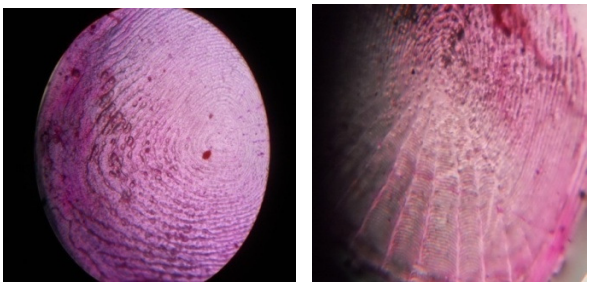


Figure- 2(a, b)
Ctenoid scales at normal condition

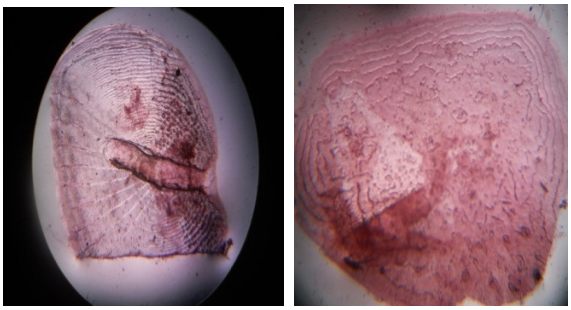
First fully developed and alternate arrange annuli in ctenoid scales at normal condition and second is scales surface are clean and origin of focus were concentrically around at the central part, chromatophore were obliquely arrange. Ctenoid scales in Tilapia under experimental condition the observation reported below were made under 6 month experimental condition:-

After the 6 month exposure of study period, ultra structure of scales of Tilapia fish change the different scales structure of different zone of fish body.

Fishes scales in fly ash (6 month): Dorsal scale of fish: In the dorsal zone of the scales were found develop and large size of scales but at the experimental period we observed to the anterior margin is irregular. In the central part of the focus are beginning to be destroyed. In this region the developing focus are totally disturbed and the alternative line of radii are unclear and overlapping on the bony ridge. Exposed part of scales show the rough surface and chromatophore are spared in this region but some developed small size of scale observes the radii are totally absent. This indicates that the annuli of scales are disappeared.



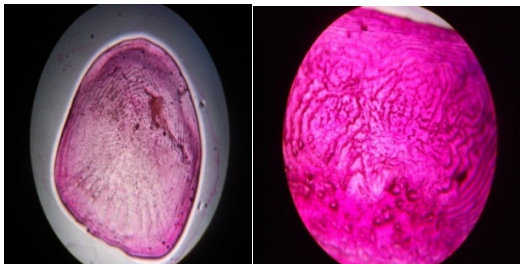
(A) Spread chromatophore(SC) (B) Overlapped annuli



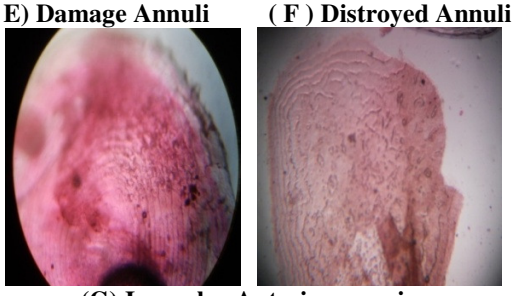
(C) Scales deformities (D) Distroyed annuli

Figure-3
(A,B,C,D) Ctenoid scales under experimental period
(Deformities of dorsal scales in Tilapia)

Ventral scale of fish: Central circuli i.e. focus are totally destroyed. Radii, annuli and all growing structure were totally diffused. The orientation of scales was changed and their surface part of scales show the rough's structure, but some originated and undeveloped structure of scales was damaged and their growth performance was very slow.



(E) Damage Annuli **(F) Distroyed Annuli**

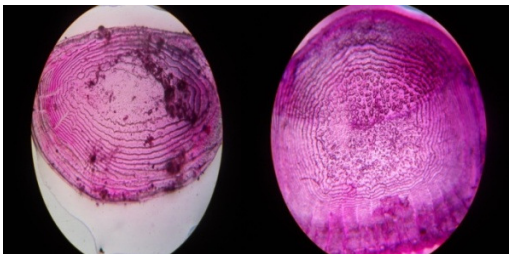


(G) Irregular Anterior margin
(H) Erosion whole stu Of scale

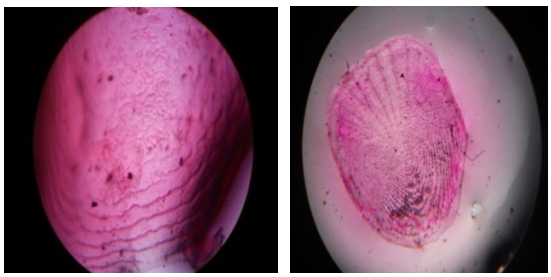
Figure-4

(E, F, G, H)Change the ultra structure of ventral side of scales under experimental period

Operculum zone: In this region large size and fully developed scales were found but their develop structure like focus, radii was damage and orientation of scales was changed. The exposed part of scales show the roughly and arrangement of chromatophore was spread and unclear. But some small size of scales surface was not clear, chromatophore was destroyed and anterior margin was irregular.



(I) Disruption of focus (J) Unclear radii & Undeveloped annuli

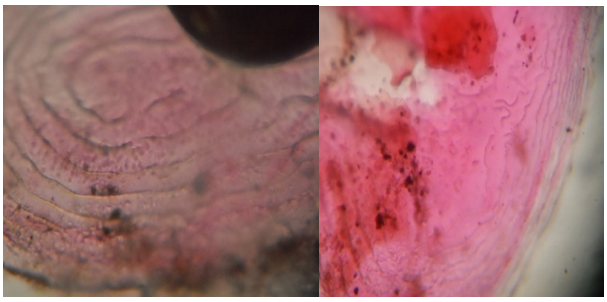


(K)Destroyed whole ultra structure
(L)Gradually erosion of anterior margin

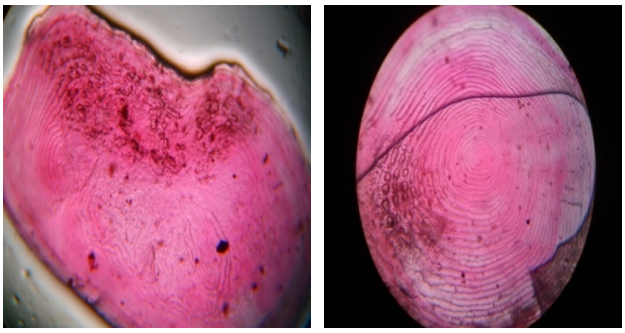
Figure-5

(I, J, K, L) Damage Ultra structure in Head zone

Tail zone: In this region mostly small and undeveloped scales are found. In this part we look the actual affect of the fly ash pollutant .caused of the pollutant we observe the orientation and shape of scales was damage and irregular. Their main structure like focus radii etc are totally destroyed and erosion of developing structure. Scales surface was rough and unclear. Chromatophores were absent.



(M)Undeveloped ultra structure in tail zone
(N) Disruption of anterior margin Rough surface



(O) Destroyed undeveloped scales
(P)Undeveloped chromatophore and Undeveloped Annuli

Figure-6

(M, N, O, P) Damage the ultra structure of undeveloping scales in tail zone

Discussion: After the study, three new observations were reported in this study: The increase in the fly ash pollutant affects the developing structure of scales and cause damage in the developing structure, scales deformities and gradually block the function of scales. In the original, growing, undeveloped scales were totally destroyed and erosion was seen in the growth of scale structure. The growth ability of fish has been lost at the duration of exposure. In the exposure period, with the increase in the concentration of fly ash pollutant, the toxicant level was also very high. The accumulation was increased in outer most protective layer like scales absorb the pollutant and change the ultra structure of scales in fish body. Hence the developing structure were partially damaged but some undeveloping, small ,soft, calcified originating scale in dermis part , their developing ability was gradually lost. Our present study has proved that the environmental factor affects the body system right from the first line of efence. In polluted water fishes, which have

been considered as representatives of environmental models for pollution exposure are the best examples for this theory. However the high concentration of fly ash pollutant indicate that effect on the ultra structure character of scales viz the shape , the focus and origin and arrangement of radii and their function with growth performance of body system were related to exposure concentration and duration.

It was observed that the reaction and survival of aquatic animals depend not only the biological state of water and physio – chemical characteristics of water but also on the kind, toxicity, type and duration of exposure. So these pollutants accumulate on the outer most protective layer of scales and enter to the integumentry system through absorption and gradually erosion to the ultra structure of scales in various ways. As a result ultra scales deformities is seen, gradual damage of the structure and block of the scales function. Its also seen these pollutant primarily affect the fully developed scale and slowly affect the dermis region Hence soft, calcified scale structure were destroyed. The scale is related to an abundant supply of food and good growth but these damage ultra structures of scale provide a poor supply of food and poor growth of the body system. So the fish scales tolerate the maximum stress of adversely affect the high concentration of fly ash pollutant. Therefore mainly affect the ultra structure of scales and growth performance of fish scales as a compare another part of integumentry system. Furthermore, metal induced alterations in the protein content may probably affect the enzyme mediated bio defense mechanism of fish[1]. So the accumulation were increased on the integumentry system specially scales and fish progressively lost their growth ability to respond to this increase in exposure period.

Conclusion

Thus as in the current study it is seen that the exposure of Tilapia to fly ash polluted water causes significant changes in the outer most that is the first protective layer, scales, which were destroyed and damaged right from the first whorl to the damage development in the overall ultra structure and it is presume that they will gradually block the function and formation of scales in the fishes.

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