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CERTAIN CRITICAL OBSERVATIONS ON MELANOPHORES AS BIOMARKER OF WATER POLLUTION

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ABSTRACT

Recently, first time in entire cultural history, man has faced one of the most horrible ecological crisis - the problem of pollution of his environment which some time past was pure, virgin, undisturbed, uncontaminated and basically quit hospitable for man. The presence in or introduction into the environment of a substance having harmful or poisonous was felt by man now. Pollution is an undesirable change in physical, chemical or biological properties of air, water and soil, which directly or indirectly affect human beings. (Odum 1971). This may harmfully affect human life or that of desirable species, our industrial processes living conditions and cultural assets. In other words pollution is used to refer harmful materials introduced by man into the environment. Thus in a way, pollution is used to release in excess of permit table limit of foreign substances within the environment (Michal 1984).

Keywords:
Water Pollution, environment, Melanophores.

INTRODUCTION

Every human society be rural, urban, industrial and most technologically advanced society dispose of certain kinds of by product and waste product which when are injected into the biosphere in quantities so great that they effect the normal functioning of ecosystem and have an adverse effect on plant, animals and man are called pollutant. These pollutants may be natural pollutants or synthetic man made, anthropogenic or xenobiotic pollutants some of them are either biodegradable pollutants or non-biodegradable pollutants.

Our earth seems to be unique among the other known celestial bodies. It has water which cover three fourth of its surface and constitutes 60-70 wt% of living world. Water is one of the prime elements responsible for life on earth. Water is a universal solvent. The great solvent power of water makes the creation of absolutely pure water a theoretical rather than practical goal. Even the highest quality distilled water contains dissolved gases and a slight quantity of solids. The problem, therefore in one to determining what quality of water is needed. The problem is further compounded because every use to which water is put washing irrigation, flushing away wastes, cooling, making paper etc add something to the water. Rivers and tanks have been used to dumping human sewages, idol immersion, industrial wastes of every conceivable kind, many of them are highly toxic added to thus be the materials leached and transported from land by water percolating

through the soil and running off its surface to aquatic surface. This causes water pollution and one that does not respect nation boundaries.

The term water pollution is referred to any type of aquatic contamination between following two types (I) a highly enriched over productive biotic community such as a lake or river with nutrients from sewage of fertilizer (cultural euthrophication) (ii) a body of water poisoned by toxic chemicals which eliminate living organism or ever exclude all forms of life (Southwick 1976)
The major effluent causing pollution in riverine and estuarine system of India are the Industrial wastes from the factories like textiles, distilleries , petrochemicals oil refineries, fertilizer etc. Toxic chemical, component in effluent from industries large water bodies of India include cyanides heavy metals like AS, Cr, Zn, Cd, Cu, Ni, Pb, Hg amino phenols pesticides like BHC.,DDT. Malathion, Paraffin, acid and alkaline (Krishnamurthy and Vishwanathan 1991). This chemicals cause abnormal metabolic changes, behavioural stress, bioaccumulation immune suppression , carcinogenicity and many other toxicological manifestation among fish. In addition to this Variation in pH, Dissolved oxygen, temperature turbidity and tropic state of water also cause stress, morbidity and mortality in fishes. (Krishna Gopal 1993).

A toxic heavy metal is any relatively dense metal or metalloid that is noted for their potential toxicity especially in environmental context. For example lead, cadmium, zinc, chromium etc.
Lead is highly toxic metal as it is reported to responsible for death or sub lethal changes of in reproduction, growth and behaviour of the fish (Ramsdorf et al 2009). Lead in form of Pb^{2+} is most common more stable ion in aquatic environment and has strong tendency to get bio accumulate in fish organs like gills, kidney, liver, muscles, scales and skin (Spokes et al 2006) (Ahmed and Bibi 2010), Under the Exposure of water having lead, fish exhibits a wide range of neurological and muscular abnormalities growth, inhibition, reproductive problems and mortality (Tekala 2003)
Chromium is used extensively in industries to produce pigment and dyes. Chromium accumulates in fish body as much 4000 times greater than their surroundings.

The metallic ions pollution of fresh water bodies is a serious problem for human directly because the aquatic organism especially fish is an integral part of human diet (Subathra et al 2007)
Some metal are essential for normal physiological functioning of fish but become toxic when they accumulate in their body tissue. In addition significantly higher concentration of metals in fish can alter its physiological functioning and that could lead to high mortality and ultimately loss of indigenous fish biota (Avenate olden age and Max 2000)

Cobalt as essential metal performs important biochemical function but in higher concentration in aquatic ecosystem become toxic to fish as interferes with the enzyme system (Yaqub and Javed 2012)

BIOMARKER OR BIOINDICATOR

The definition of biomarkers has been enunciated in many different forms a reflection of their intense uses in the environmental science over the past decades. In essence biomarker is any indicator of stress agent that somehow affecting an organism's ability to grow, reproduces, survive and adapt in a given environmental condition. The term biomarker accurately refers to an indicator at a sub individual or at individual level of organization. This indicator may be alteration in molecular or biochemical process, cellular structures of mass and length ratio of individual organs

of the whole bodies. Various aquatic organisms occurs in lakes and river and sea potentially useful as biomarker of toxic water pollutants including fish oyster, muse, aquatic animals and aquatic plants and algae.

MELANOPHORES AS BIOMARKER

Melanophores are specialized cell derived from the neural crest that contains membrane bond vesicles called melanosome. Membranes are filled with melanin a dark non fluorescent pigment that plays a principal role in physiological colour adaption of animals. Melanophores regulate melanosome trafficking on cytoskeleton filaments to generate a range of striking colour pattern. The mechanism of physiological colour change by these melanophores encompasses both physical and biochemical aspects of melanosomes dynamics.

Melanophores that contain black or dark brown pigment granules (melanasome) men bran bound organelles that contain malain, Melanin a polymer of high molecular weight and great stability that is synthesized from phenylalanine and tyrosine (Bagnara and Hadley 1973). The melanasomes are transport along microtubules at rate of about 1 um/sec (about the same rate as fast axonal transport) either towards or away from cell centre. When pigment cell granules are aggregated in the cell centre, most of cell is unpigmented and animal bearing such cells would appear lightly coloured. When pigment granules are uniformly pigmented and animal bearing such cells would appear darkly coloured. Melanophores disperse or aggregate their melanosomes when host requires changing its colour in response to the environmental cues (e.g. camouflage or social interaction)

Fish are well recognized biomarker of environmental changes including chemical pollution. (FAO/SIDA 1983, Espino 2000) since span over a wide verity of feeding and living habit, they are exposed to chemical contamination from different food sources and water conditions. Fish can be found virtually everywhere in aquatic environment and play a major ecological role in aquatic food webs because of their function as energy carries from lower to higher tropic levels.

Melanophores of fishes are directly exposed to the water and contaminated pollution status of water and can several by change in colour (Pandey et al 1981). Many measures chromatogram present in fish skin serves as very useful biomarker of risk assessment of xenobiotics (Das and Gupta 2009-2010). The understanding of toxicant uptake, behaviour and responses in fish may there have a high ecological relevance. They are also an important link between the environment and human population through fisheries and consumption by local and other makes (FAO/SIDA 1983, Espino 2000)

METHODOLOGY

Sample of fish were collected with the help of professional local fisherman. Healthy and active fish were separated and maintained at least for ten days and fed on commercial and formulated dry palled feed. The physicochemical parameters of used water throughout experiment according to APHA (1998) will be recorded.

During the experiment healthy fishes of uniform size and weight were selected for experiment.

For chromic treatment experimental group of fishes will be exposed to copper and lead up to 28 days at the end of 7, 14, 21, 28 days experimental fish will recorded. Changes in number and dispersion of melanosomes are also recorded i.e.the LC 50 concentration of metals toxicity.
When the scales of fish are removed, alternation changes in melanophore will be observed. The melanophore size index will be the parameter for recording the response of melanophore.

RECORDING OF MELANOPHORE RESPONSES

Hogben and stome (1931) developed a so called melanophore Index (MI) which is in use since the earliest studies of melanophore responses to melanotropins. In this microscopic assay, the degree of melanosome dispersion is determined according to 5 point scales, to field a melanophore index that ranges between 1 and 5. This method employs 5 distinct stages representing different degrees of pigment dispersal within the melanophores. The most aggregated state is designated as stage 1 and the most desperado as stage 5, stage 2, 3, and 4 represent inter mediate degree of pigment dispersal. As pointed out by Bargnara and Hadley (1973), by using this system an index of the relative dispersal of melanosomes can be obtained from quantitative use or for graphic representation. Based on this system the degree of melanosome dispersion was determined.

OBSERVATIONS

It was observed that higher concentration of toxic metal Lead in polluted water might have induced and altered activity of melanophores. Rate of melanosomes dispersion increase due to the concentration of toxic heavy metal in water. Observations show presence of excess Lead in fresh water. It was observed that fish colour darkens due to dispersion of melanosomes.

RESULTS

Present study shows that water pollution due to toxic pollutants bring changes in hydro chemical properties and cause damage to aquatic ecosystem. Pollution due to toxic metal like lead may change hydro chemical parameters of water and cause damage to aquatic ecosystem for example increase in Ph, temperature, acidity and BOD.

Behavioural changes were recorded in fins movements, swimming performance and it is observed that responses of fishes to the external stimuli decreases significantly with more consumption.Fish skin is unique for its dynamic pattering speed of change due aggregation and dispersion of chromatophores. Chromatophores are pigmentary organs that act simply as selective colour filter. Change in colour of Aquatic organisms is a warning of toxicity.
Change in functioning of chromatophores changes the colour of fishes. With this early observation we can detect presence of pollutants in water.

CONCLUSION

The present study suggests that melanophores can be used successfully as bio marker of water pollutions mainly for heavy metals like Lead and chromium.

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