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A STUDY ON EFFECT OF HEAVY METALS ON DIFFERENT PROPERTIES OF AQUATIC ECOSYSTEM

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ABSTRACT
Heavy metals, pesticides, sewage, oil, and other pollutants in freshwater and marine environments have all been considered among the most serious threats to the environment. Human and ecological health as well as certain subtypes of illness, death, and disability is constantly impacted by the environment. Modern toxicological research is uniquely benefited by a wide range of fundamental sciences and medical specialties. Applied and translational research in this area quickly progresses into clinical applications and/or public health decision making since toxicology ultimately aims to identify compound-mediated harm and prevent or counteract any damage that could occur from exposures to particular substances. Pesticides are widely utilized across the globe to safeguard crops and the general public's health. In order to satisfy the demands of an expanding population and prevent vector-borne illnesses, greater production of food and fiber is crucial, and pesticides play a key role in this. However, the majority of sprayed pesticides impact creatures that are not their intended targets since they are released into the environment as a variety of toxicants, both recognized and undiscovered.

Keywords: - Metals, Aquatic, Fish, Human, Biological System.

I. INTRODUCTION

The problem of heavy metals accumulation in aquatic organisms including fish needs continuous monitoring due to biomagnifying potential of toxic metals in human food chain. Due to the damage caused to the aquatic life, the pollution of freshwaters with a wide range of metals has become a matter of great concern over the last few decades. Heavy metals may enter into aquatic ecosystems and induce stress symptoms in fish. Some metals are essential since they play an important role in biological systems, while some others are nonessential metals as they have no known role in biological systems. One of the most important characteristics of toxic pollutants such as metals is that they can be accumulated in organs of the organisms. Fish have been largely used in the evaluation of the quality of aquatic systems. These organisms are often at the top of the aquatic food chain and may concentrate large amount of metals from the surrounding waters. The accumulation of metals in aquatic systems suggests that fish may serve as a useful indicator of contaminating metals in aquatic systems, since they respond with great sensitivity to changes in the aquatic environment

Micro plastics (MPs) are defined by as "synthetic solid particles or polymeric matrices, with regular or irregular shape and with size ranging from 1 µm to 5 mm, of either primary or secondary manufacturing origin, which are insoluble in water". A key concern of micro plastics pollution is whether they represent a risk to ecosystems and human health. However, there is much uncertainty associated with this issue. Data on the exposure and effect levels of micro plastics are therefore required to evaluate the risk of micro plastics to environments and human health. The adverse effects on organisms that are exposed to micro plastics can be separated into two categories: physical effects and chemical effects. The former is related to the particle size, shape, and concentration of micro plastics and the latter is related to hazardous chemicals that are associated with micro plastics. Though data on micro plastic exposure levels in environments and organisms have rapidly increased in recent decades, limited information is available on the chemicals that are associated with micro plastics. Micro plastics can contain two types of chemicals: (i) additives and polymeric raw materials (e.g., monomers or oligomers) originating from the plastics, and (ii) chemicals absorbed from the surrounding ambience.

Additives are chemicals intentionally added during plastic production to give plastic qualities like color and transparency and to enhance the performance of plastic products to improve both the resistance to degradation by ozone, temperature, light radiation, mold, bacteria and humidity, and mechanical, thermal and electrical resistance. They include inert or reinforcing fillers, plasticizers, antioxidants, UV stabilizers, lubricants, dyes and flame-retardants. Among the charges, wood and rock flour, clay, kaolin, graphite, glass fibers, cotton flakes, jute or linen, cellulose pulp, etc. are used. According to the definitions proposed by the American Society for Testing and Materials (ASTM-D-883), inert fillers are materials that are used to modify the strength, working and flow properties, and shrinkage of plastics, while the reinforcing ones, also called fillers, are defined as those with some strength properties that are significantly superior to those of the base resin.

These fillers (such as carbon black in rubber), which are mixed in with the polymer, result in an interface volume that is generated at the filler-resin contact surface. It is the superior properties of this interface layer that obtain increased modulus and mechanical properties such as impact strength or tensile strength in the composite polymer. As the effect is surface-related, the smaller particle sizes of fillers generally yield a better reinforcing effect. There are clays, silica, glass, chalk, talc, asbestos, alumina, rutile, carbon black, and carbon nanotubes

II. AQUATIC TOXICITY BY METALS

Heavy metals are a major environmental threat because they disrupt the aquatic environment and endanger the lives of humans, plants, and animals. Heavy metals are entering aquatic systems at an alarming rate. A key issue that has been brought to light over the past several decades is the alarming rise of heavy metal metals over their normal loads in aquatic environments.

Human activities including industrialization, urbanisation, and farming all contribute to the discharge of effluents into water systems either directly or indirectly through rivers, leaching, or drainage. Heavy metals and biologically active chemicals can bioaccumulate in marine biota and food webs. Therefore, health, growth, growth, and survival are all factors that impact fish. Heavy metals are distinguished by a high affinity for living systems and a correspondingly sluggish clearance rate from biological tissues.

Cadmium

In both the earth's crust and aquatic ecosystems, cadmium is the most toxic and necessary heavy metal. High quantities of cadmium in phosphate fertilisers, such as superphosphate fertiliser, may be explained by the fact that cadmium exists naturally in particular phosphate rocks. Due to rising urbanisation and industrialisation, cadmium production and consumption have skyrocketed in recent decades.

Zinc

Zinc is a fundamental and widely distributed heavy metal pollutant. Which are part of the cytoplasm's conservation function and can be detected in natural waterways due to rock weathering or human activities like wastewater and waste disposal.

Lead

Lead heavy metals found in residues pose a serious threat to freshwater supplies. Lead is emitted into the environment largely through car exhaust pipes since it is found in gasoline.

Copper

Lagos lagoon, which includes urban and industrial trash from the interior, is enriched with copper and other heavy metals. Copper and Hepatitis can be ingested through the gills, and the digestive tract can be another entry route.

III. POLLUTION INDUCED HISTOPATHOLOGICAL AND BIOCHEMICAL CHANGES

Pathological alterations are caused by water contamination in aquatic organisms. Changes in cells and tissues brought on by a toxicant can serve as reliable biomarkers. Both the inability to stay alive in the presence of toxicants and the attempts to restore homeostasis are reflected in the alterations. Histological analysis of an exposed organism's liver, for instance, may indicate many necrotic cells. Inflammation might be taking place in the same tissue as a means of isolating, removing, and replacing damaged cells. Biomarkers are often used, and two of the most prevalent are necrosis and inflammation. Histological biomarkers include morphological alterations as well as cellular abnormalities such as the accumulation of damaged biomolecules or cells adapted to deal with toxicant damage. To ascertain potential cellular alterations in target organs, histological analysis appears to be a highly sensitive measure. Histology is an important biomarker of exposure to pollutants, especially for non-fatal and chronic consequences.

Before noticeable changes in fish behaviour or outward appearance may be noticed, the earliest harmful impacts of pollution may only be visible at the cellular or tissue level. Fish that are subjected to chemical pollutants are likely to develop a variety of lesions. The histology study of the gills, kidney, and liver can reveal the impact of pollution. Even at sublethal concentrations, pesticides in the environment can cause biochemical, physiological, and histological changes in the essential tissues of aquatic organisms. Histopathological alterations in the gill tissues of fish exposed to different pesticides have been observed by several authors. A high correlation between exposure to heavy metals and liver lesions has been hypothesised by Atif et al. (2009) and Sorensen (1991). Heavy metals are a normal part of the environment and may be found in both underground and above ground water, but at various concentrations. However, human activities accelerate the flow of these metals into their native aquatic habitats. Extremely high concentrations of these metals can sometimes be found in aquatic organisms. Fish are known to react quickly to shifts in their environment. The condition of an aquatic environment may be gauged, at least in part, by looking at the fish population.

Health status and toxicological symptoms of organisms can be measured with the use of biochemical measures. Heavy metals interfere with many different physiological pathways. Because they hinder glutathione metabolism and a wide variety of enzymes and hormones, heavy metals are known to disrupt the normal pro-oxidant/antioxidant equilibrium. When it comes to nutrition, heavy metals act as direct antagonists to trace elements, and they compete with these elements for binding sites on transport and storage proteins, metalloenzymes, and receptors. Abnormalities in carbohydrate, protein/amino acid, lipid, neurotransmitter, and hormone metabolism are the result of a disruption in the metabolism and balance of nutritional components. Water pollution also has an effect on the body's structural components, which include proteins, carbohydrates, and lipids, and on the creation and metabolism of energy. Fish may experience biochemical and physiological changes due to water pollution, particularly from the presence of heavy metals. Some heavy metals, like lead and mercury, are well-known for their direct, devastating effects on neuronal function, while others, like cadmium and lead, have similarly direct, deleterious effects on cells in the artery wall. Heavy metals including cadmium, lead, and mercury are known to impair microtubule polymerization and assembly, which disrupts intracellular transport in neurons. Chronic, low-level mercury exposure is only one example of how heavy metals can cause deficits in certain amino acids. Heavy metals are generally considered systemic poisons having distinct neurotoxic, nephrotoxic, hepatotoxic, fetotoxic, and teratogenic effects. Heavy metals are especially toxic to lipids and proteins.

IV. BIOACCUMULATION OF HEAVY METALS IN AQUATIC ECOSYSTEM

Due to their toxicity and accumulation in biota and fishes, heavy metals have garnered a lot of attention in the aquatic ecosystem. Metals' harmful impact on aquatic habitats ranged from eradication of all biota to more subtle changes in the reproduction, growth, and death rates of organisms. Because of the ease with which metals may be absorbed and carried by water, aquatic biota is particularly vulnerable to their toxic effects. Most organisms are exposed by inhalation of free ions from water, however buildup in the food chain and ingestion of contaminated sediments can also lead to exposure. Heavy

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metal concentrations in sediment can be three to five times higher than water concentrations, making bottom sediments both a sink and a source for toxins. High metal levels in sediments, macrophytes, and benthic organisms are more indicative of heavy metal contamination in aquatic environments than are high concentrations in water itself. Fish may be at risk if they consume invertebrates that live in the silt. Because of this, biomagnification occurs as heavy metals accumulate in fish populations. Fish absorb heavy metals through their absorbent epithelium/gills and by other non-dietary channels as well as through direct intake of water or biota.

Heavy metals can be ingested by aquatic organisms via a wide variety of environmental sources, including as sediments, soil erosion and runoff, air depositions of dust and aerosol, and discharges of waste water. Metal concentration studies conducted on sediments and Tilapia fish caught in Hong Kong's inland waters showed that the total concentrations of copper, zinc, lead, nickel, cadmium, and chromium in river sediments and different organs of fish (caught from the river) were significantly higher than those caught in the fish pond. Metals in sediments were shown to have significant associations with various fish tissues. Because of this, the buildup of heavy metals in aquatic organisms can have far-reaching consequences for biogeochemical cycling in the ecosphere. Fish development might be stunted by heavy metals as well. One possible mechanism by which fish accumulate toxic levels of metals from water is through their position as apex predators in aquatic food webs. The variation in fish absorption and depuration times across metals is a major contributor to metal bioaccumulation. Metal buildup in various fish tissues can be influenced by a number of factors, including time of year, water temperature, and water chemistry. The gills are immersed in the liquid. Metals in the gills reflect metals in the water the fish lives in, whereas metals in the liver indicate metals stored in the water.

V. CONCLUSION

In recent decades, a number of human-made chemicals—including organochlorines, organophosphasates, carbamates, and synthetic pyrethroids—have come to be seen as a serious threat to the biota and their environment. Increasing global usage of pesticides poses serious health risks to humans.

Labeo rohita were used as a test subject because of their susceptibility to the toxicity of the thiocarbamte, cartap hydrochloride, which was investigated in this study. Cartap hydrochloride was shown to be mildly harmful to the test fish, Labeo rohita, in this study. The continual maintenance of the toxicant concentration in the flow-through system is likely the reason why the LC50 values of continuous flow-through systems are lower than the static values. Bioaccumulation by fish, pesticide uptake by the toxicant chamber walls, and chemical breakdown all contribute to higher values in a static system.

When the fish, Labeo rohita, were exposed to a sub-lethal dose (1/10th of 96 h static LC50) of cartap hydrochloride for 4 days, they exhibited a number of abnormal behaviours, including irregular swimming patterns and an overall appearance of distress. The fish's opercular motions sped up during the second day, and it surfaced more often panting for air, although the difficulties it had breathing thereafter seemed to abate. Test fish, Labeo rohita, exhibited hyperexcitation, loss of balance, an increased cough rate, gill flaring, an increase in gill mucus production, darting movements, and striking against the walls of test tanks.

REFERENCES

1. Strungaru, S.-A.; Pohontiu, C.M.; Nicoara, M.; Teodosiu, C.; Baltag, E.S.; Jijie, R.; Plavan, G.; Pacioglu, O.; Faggio, C. Response of aquatic macroinvertebrates communities to multiple anthropogenic stressors in a lowland tributary river. Environ. Toxicol. Pharmacol. 2021, 87, 103687.
2. Burgos-Aceves, M.A.; Abo-Al-Ela, H.G.; Faggio, C. Impact of phthalates and bisphenols plasticizers on haemocyte immune function of aquatic invertebrates: A review on physiological, biochemical, and genomic aspects. J. Hazard. Mater. 2021, 419, 126426.
3. Dar, O.I.; Aslam, R.; Pan, D.; Sharma, S.; Andotra, M.; Kaur, A.; Jia, A.-Q.; Faggio, C. Source, bioaccumulation, degradability and toxicity of triclosan in aquatic environments: A review. Environ. Technol. Innov. 2022, 25, 102122.
4. Pagano, M.; Stara, A.; Aliko, V.; Faggio, C. Impact of neonicotinoids to aquatic invertebrates—in vitro studies on Mytilus galloprovincialis: A review. J. Mar. Sci. Eng. 2020, 8, 801.
5. Jordanoska, L.V., Kostoski, G. and Jordanoska, B., 2008. Antioxidative enzymes in fish as biochemical indicators of aquatic pollution. Bulgarian Journal of Agricultural Science, 14, 235-237.
6. Yaji, Abubakar Jerma & Ogueji, Okechukwu, & Ekpenyong, Joshua. (2021). Sublethal behavioral and biochemical toxicity of cypermethrin in juvenile Oreochromis niloticus in a static bioassay. Fisheries & Aquatic Life. 29. 148-157. 10.2478/aopf-2021-0016.