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EFFECTS OF HEAVY METALS ON FISH

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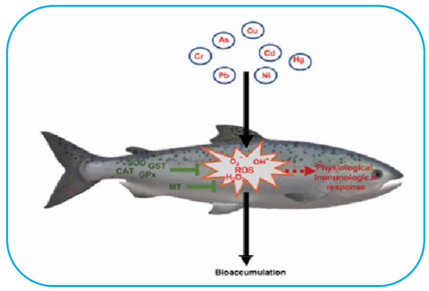
ABSTRACT:

Heavy metals are matters that form the most dangerous side of chemical water pollution due to their ability to bio accumulate and bio magnify and cannot be eliminated from the body by metabolic activities. In this study literature is reviewed by examining studies on general characteristics and sources, uptake by fish, concentration evaluations and effects on fish and other aquatic organisms of heavy metals such as cadmium, copper, manganese, nickel, iron and lead. Studies examined showed that heavy metals cause severe damage on fish thus endanger fish health and ecosystem and constitute respectable risks for human health via consumption of heavy metal contaminated fish.



KEYWORDS: *Bio accumulate, Bio magnify, Heavy Metals and Fish .....etc.*

INTRODUCTION:

There are several ways to describe the term " heavy metals " in the literature. It's frequently used as reverse for trace metals and includes essential and gratuitous metals that have high infinitesimal weight and lesser viscosity than that of water. Heavy metals is chemically defined as each count that can come electron patron and valence ion, can switch places with H ions in acids, can form composites with nonmetals but can not form with each other and has alkaline oxides. In physical terms it's defined as each count that can conduct heat and electricity well, can be converted into metals plate and line, has a metallic colour and lustre and is solid under normal circumstances except mercury. But when it comes to goods of them, anyhow of its description any metals may be called heavy metals if it's poisonous to any organism under any circumstances.

Heavy metals naturally live in colorful attention in earth's crust, soil, air, water and all natural matter and they've been spread extensively as a result of anthropogenic conditioning similar as cement product, iron sword assiduity, brume power shops, glass product, scrap and waste slush incineration installations, mining activites, smelters and foundries, pipeline, combustion and business. Pollution and corresponding pitfalls that come into actuality by this rapid-fire increase in agrarian conditioning, population growth, urbanization and industrialization are critical issues about terrain. There's no mistrustfulness that the most dangerous chemical pollution in water is heavy metals impurity. Heavy metals constitute a significant ecological and health concern due to their toxin and capability to accumulate in living beings. Heavy metals have a strong influence on the stability of ecosystems but also have adverse goods on humans. Indeed though some of the heavy metals similar as zinc, iron, cobalt and bobby are essential for enzymatic exertion and other natural processes at low situations they come poisonous when they exceed certain limit. On the other hand other metals similar as lead, cadmium and mercury have no essential part in living organisms and are poisonous indeed at too low attention(Bryan, 1976).

Heavy metals do not river in water and settle down swiftly onto sediment due to their higher density than that of water. This was demonstrated with Cd and Cu exposure, metals showed 72 to 97% decrease from their initial concentration after 96 hours of experiment (Ghosal and Kaviraj, 2002; Ghosh et al., 2016; Ghosh et al., 2018).

UPTAKE OF HEAVY METALS BY FISH

Heavy metals are substantially poisonous, can beget severe damage and come murderous for utmost organisms since they're suitable to bioaccumulate and biomagnify. Bioaccumulation means an increase in the attention of a xenobiotic in an organism over time compared with xenobiotic attention in the terrain(Govind and Madhuri, 2014). Biomagnification means transfer of a xenobiotic from food sources to an organism, performing a advanced attention in the organism than the sources(Connell, 1989). Uptake of heavy metals by fish from the terrain primarily occurs through gills, food, skin and in brackish fish through water taken with food and taken heavy metals are carried to organs by carrier proteins via blood path and can reach high attention by relating to metals list proteins in these apkins. The poisonous element attention in fish derivers on coitus and age of fish, season and place. Pollution of water sources by anthropogenic conditioning leads to submarine loss and thus disrupts the balance of food chain(Afshan etal., 2014).

EFFECTS OF HEAVY METALS ON FISH

Some of the aquatic organisms can store heavy metals up to certain amount. Even though these heavy metals are not harmful or toxic, they can reach to humans via food chain and affect human health. As a general rule toxicity occurs when heavy metal concentrations reach above certain levels. Also heavy metals piled in water join to the food chain from many stages and threaten ecosystem safety, fish and human health. Fish are at the top of the aquatic food chain, and they can accumulate preexisting metals in various tissues and organs. Aquatic organisms such as fish and shell fish accumulate metals to concentrations many times higher than present in water or sediment (Gumgum et al., 1994; Al-Weher, 2008). Accumulated metals in fish tissues up to toxic concentrations are based on certain environmental conditions such as food chain, predation competition, water chemistry (salinity, pH, water hardness,) and hydrodynamics in the water (Al-Weher, 2008). Furthermore, interaction between metals may also influence accumulation.

Studies carried out on fish revealed that all heavy metals, despite the fact that some of them are essential for life, have adverse effects on living organisms through metabolic interference and mutagenesis. These adverse effects are decrease in fitness, interference in reproduction that leads to carcinoma and eventually death (Govind and Madhuri, 2014). In addition to reproduction, hypoxic conditions, excessive stocking and starvation, heavy metal effects also cause stress in fish (Levesque et al., 2002). Stress factors including pollution affect growth, development and reproduction adversely by changing metabolic, physiological and biochemical functions.

Adverse impacts on physiological functions and biochemical parameters both in blood and tissue of the fish living in metal contaminated waters have been observed. It has been reported that fish exposed to metals showed immune system malfunction and thus became vulnerable to contagious diseases and had a greater mortaliy risk. In despite of carcinogenic effects of heavy metals are not known well, several studies suggest genotoxic effects may exist (Snow, 1992). Heavy metals enhance genotoxicity either directly or indirectly by inducing toxicity of other chemical agents (Bolognesi et al., 1999). Heavy metal exposure reduces estrogenic and androgenic secretion and also causes pathological changesi in fish.

EFFECTS OF CADMIUM (CD)

Cadmium exhibits high toxicity at even very low concentrations and has acute and chronic effects on fish and environment. Long exposure of cadmium poses various acute and chronic effects on aquatic living beings. Such effects are enhancement of humoral immune response inducement of structural and functional changes in gill, intestine, liver and kidney (Kumar and Sing, 2010), pathological alterations in liver such as congestion, necrosis of pancreatic cells and fatty changes in the peripancreatic hepatocytes, congestion and engorgement of blood vessels. It also causes disruption of calcium metabolism, hypercalciuria and leads kidney stones to form. Toxicity varies in fish, salmonids are highly susceptible to cadmium exposure and sublethal effects such as obvious spine malformation were reported. In rosy barb (Puntius conchonius) short term effect of high concentrations of Cd caused hyperglycemia, whereas long term effect of low concentrations of Cd caused hypoglycaemia and liver glycogen.

EFFECTS OF COPPER (CU)

Copper reduces resistance of fish to diseases by disrupting migration; altering swimming; causing oxidative damage; impairing respiration; disrupting osmoregulation structure and pathology of vital organs such as gills, kidney, liver and other stem cells. Cu exposed different fish species posed behavioural changes such as decrease in swimming ability and food intake and increase in operculum movements. Findings of Arslan et al. revealed that these changes went back to normal with longer exposure durations. Singh and Reddy (1990) and James and Sampth (1995) showed that cu effect on different fish species led a decrease in muscle and liver total protein and an increase in free amino acids concentration and gluconeogenic enzyme activity (Arslan et al., 2006). Cu affects sense of smell (olfaction) in fish thus causing alterations in appetite, navigation and awareness of surroundings. It also reduces sperm and egg production, survival rates and increases abnormality incidences (Solomon, 2009).

EFFECTS OF IRON (FE)

Although iron is essential for physiological precesses in animals, it may be detrimental to living organisms at higher concentrations than optimum conditions. Debnath et al. (2012) also showed that behavioural changes, decrease in feeding rate and reduced growth occured in mrigal (Chirrhinus mrigala), catla (Catla catla) and roho labeo (Labeo rohita) larvae after iron exposure and suggested that such alterations might have taken place because of accumulation of iron in gills, therefore disrupting osmoregulation and respiration. Gill damage causes a disruption of carbon dioxide and oxygen exchange, hypercapnia, plasmatic acidosis and hypoxia (Playle and Wood, 1989; Exley et al., 1991). Some authors described iron accumulation on gills and detrimental effects whereas others only reported iron existence without any gill epithelium damage, especially at low pH values conducted a study where atlantic salmon (Salmo salar) and rainbow trout (Oncorhynchus mykiss) exposed to radioiron with intraperitoneal injection and found out that iron accumulated primarily in liver and spleen. Hb levels of both fish reduced after a single injection. Even though O.mykiss recuperated after 8 days, Hb levels of S.salar remained under the normal range. Standal et al. suggested that inverse correlation between iron level and Hb values might indicate a direct effect on erythrocytes. But when it comes to prolonged fall in Hb levels of S.salar, Standal et al. concluded that due to species disparity iron might have caused more severe damage to erythrocytes in S.salar.

EFFECTS OF MANGANESE (MN)

Sharma and Langer (2014) studied the haematological effects of Manganese ($MnSO_4$) on sucker head (Garra gotyla gotyla) and found out that Mn treated fish had decreased total erythrocyte count (TEC), haemoglobin (Hb) and haematocrit (Hct) levels whereas had increased mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) levels. Sharma and Langer suggested that toxicity of Mn caused haemopoietic organs to be affected and therefore could not release proper red blood cells (RBCs) into the general circulation. Alongside with decrease in numbers of erythrocyte

Sharma and Langer also observed that Mn affected the shape and nucleus of RBCs. Sharma and Langer suggested that these changes start the destruction process and eventually lead to complete degeneration of RBCs. Total leucocyte count (TLC) was increased as a result of Mn treatment and Sharma and Langer claimed that this may be a result of stimulation of immune system as a respond to Mn related tissue damage. According to the presented study it can be concluded that Manganese toxicity causes haematological parameters of G. gotyla gotyla to be affected adversely.

EFFECTS OF NICKEL (NI)

Ghosh et al. (2018) studied Ni toxicity on common carp (Cyprinus carpio) and suggested that Ni does not precipitate in water as fast as other heavy metals and therefore making it more bioavailable to pelagic organisms. Ghosh et al. revealed that Ni primarily accumultes in the gills of C.carpio and transportation of Ni from gill to liver, kidney, and muscle tissues is too little to detect within 96 hours of exposure and the Ni amount evaluated in the gut was negligible. Ghosh et al. concluded that Ni toxicity mainly occurs gill-mediated in C. carpio. Hughes et al. (1979) and Pane et al. (2004) suggested that primary effect of Ni is on respiratory system in fish by causing gill lamellae to swell as well as increasing oxygen consumption, ventilatory stroke volume and respiration frequency. In several studies it has been shown that Ni toxicity causes oxidative stress in goldfish (Carassius auratus), streaked prochilod (Prochilodus lineatus) and mummichog (Fundulus heteroclitus). Behavioural effects of Ni exposure were studied and found out that Ni affects locomotor activity in fish, thus causing hypoactivity in goldfish (Carassius auratus) and round goby (Neogobius melanostomus) (Leonard et al., 2014; Blewett and Leonard, 2017).

EFFECTS OF ZINC (ZN)

Zinc is an essential element but at greater concentrations it may be toxic to fish as indicated previously. Zn accumulates in the gills of fish and creates adverse effects on fish by causing structural damages that affects growth, development and survival. It also alters fish behaviour, hatchability, hematological parameters, balance, swimming ability (Afshan et al., 2014). Cicik (2003) studied the effects of Zn on common carp (Cyprinus carpio) and found out that most accumulation took place in gill tissue. Cicik suggested that high concentrations of Zn might have occured due to mucus secretion and structural alterations in gill tissue caused by contamination. In another study Buthelezi et al. (2000) examined effects of Zn exposure in mozambique tilapia (Oreochromis mossambicus). Zn caused sublethal stress and increased RBC count in fish. Buthelezi et al. suggested that such increases led enhancement in oxygen carrying capacity of the blood as against altered respiratory homeostasis took place by Zn exposure. Thus, Buthelezi et al. concluded that mentioned reaction might be considered as secondary reaction to the pollutant instead of direct stimulation of haemopoietic tissues by Zn. Buthelezi et al. also revealed that blood Hb concentrations, MCHC values and Hct were increased whereas cell Hb concentrations (MCH) were decreased. Zn also stimulated immune system by enhancing WBC count and Buthelezi et al. suggested that therefore fish are protected against possible infections due to gill damage caused by metals.

CONCLUSION

Heavy metals are largely poisonous, dangerous and dangerous environmental adulterants. In this study goods of heavy metals on fish were examined and literature review was performed. Factors impact mentioned goods can be listed as species, age, coitus, size, salutary habit and preferred niche of fish; physical and chemical parcels of water; and heavy metals relations with each other and bioavailability. Heavy metals beget damage to capability of growth, development, reduplication, aliment and survival of fish by affecting physiological, biochemical, metabolic, systemic and inheritable functions. Since heavy metals are biologically imperishable and both humans and fish can not metabolise them, indeed if they don't exceed poisonous attention in fish, they may reach up to humans via consumption of fish and beget severe health problems. Although this composition mentions the adverse goods of heavy metals, humanity presumably represents the most poisonous species lived on earth, causing these and other pollutants to intrude with nature. According to the studies examined in this composition, the quantum of heavy metals in comestible corridor of fish in some regions exceeds the limits specified in currentregulations.However, unwanted consequences should be anticipated to be in the near future, If environmental pollution continues to increase at the current rate. It's essential for affiliated public or transnational associations to take preventives about environmental adulterants, prepare necessary regulations and use advanced technologies to reduce forenamed pollution. Consequently, studies on discovery of heavy metals, disquisition of heavy metals goods on living brutes and reduction of environmental pollution should be conducted.

REFERENCES

- Al-Weher, S.M. 2008. Levels of Heavy Metal Cd, Cu andZn in Three Fish Species Collected from the Northern Jordan Valley, Jordan. Jordan Journal of BiologicalSciences.1(1): 41-16.
- Blewett, T.A., Leonard, E.M. 2017. Mechanisms of nickel toxicity to fish and invertebrates in marine and estuarine waters. Environmental Pollution.223: 1-12.
- Bryan, G.W. 1976. Some aspects of heavy metal tolerance in aquatic organisms. In: A.P.M. Lockwood (Ed.), Effects of Pollutants on Aquatic organisms. Cambridge University Press., UK: 7-34
- Buthelezi, P.P., Wepener, V., Cyrus, D.P. 2000. The sublethal effects of zinc at different water temperatures on selected haematological variables in Oreochromis mossambicus. African Journal of Aquatic Science. 25: 146–151.
- Connell, D.W. 1989. Biomagnification by aquatic organisms-a proposal. Chemosphere 19: 1573–1584.
- Debnath A. and Markonics G. (2012) Heavy Metals Toxicity and the Environment. EXS. 101: 133–164.
- Ghosal, T.K., Kaviraj, A. 2002. Combined effects of cadmium and composted manure to aquatic organisms. Chemosphere. 46(7): 1099–1105.
- Ghosh, A., Kaviraj, A., Saha, S. 2018. Deposition, acute toxicity, and bioaccumulation of nickel in some freshwater organisms with best-fit functions modeling. Environ Sci Pollut Res. 25: 3588–3595.
- Govind, P.,Madhuri, S. 2014. Heavy Metals Causing Toxicity in Animals and Fishes. Research Journal of Animal, Veterinary and Fishery Sciences. 2(2): 17-23.

- Govind, P.,Madhuri, S. 2014. Heavy Metals Causing Toxicity in Animals and Fishes. Research Journal of Animal, Veterinary and Fishery Sciences. 2(2): 17-23.

- Gumgum, B., Unlu, E., Tez, Z., Gulsun, Z. 1994. Heavymetal pollution in water, sediment and fish from the Tigris river in Turkey. Chemosphere. 29: 111-116
- Kumar, P., Sing, A. 2010. Cadmium toxicity in fish: An overview. GERF Bulletin of Biosciences. 1(1): 41-47.
- Leonard, E.M., Marentette, J.R., Balshine, S., Wood, C.M., 2014. Critical body residues, Michaelis-Menten analysis of bioaccumulation, lethality and behaviour as endpoints of waterborne Ni toxicity in two teleosts. Aquat. Toxicol. 23: 147-162.
- Levesque, H.M., Moon, T.W., Campbell, P.G.C.,Hontela,A. 2002. Seasonal variation in carbohydrate and lipid metabolism of yellowperch (Percaflavescens) chronically exposed to metals in the field. Aquatic Toxicology. 60(3-4): 257-267.
- NY. Hughes, G.M., Perry, S.F., Brown, V.M., 1979. A morphometric study of effects of nickel, chromium and cadmium on the secondary lamellae of rainbow trout gills. Water Res. 13: 665-679.
- Rainbow, P.S. 1995.Biomonitoring of Heavy Metal Availabilityin the Marine Environment. Mar. Poll. Bull. 31: 4-12, 183- 192.
- Singh, H.S., Reddy, T.V. 1990. Effect of copper sulfate on hematology, blood chemistry and hepato-somatic index of Indian catfish, Heteropneustes fossilis (Bloch), and its recovery. Ecotoxicol. Environ. Safety. 20: 30- 35.

- Solomon, F. 2009. Impacts of Copper on Aquatic Ecosystems and Human Health. Environment & Communities.

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