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Potential Effects of Heavy Metals on Aqua Culture

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ABSTRACT: Heavy metals naturally exist in very little amount in water body. Aquatic organisms absorb the pollutants directly from water and indirectly from food chain. The toxic effects of heavy metals on aquatic life's are reduction of growth , reduction of survival. Heavy metals can have toxic effects on different organs. They can enter into water via drainage, atmosphere, soil erosion and all human activities by different ways. As the heavy metals concentrated more in the environment, they enter biogeochemical cycle, leading to toxicity. The heavy metal contamination of Pavana river of pune city during monsoon, pre monsoon and post monsoon season was asses through quantitative analysis. In this review the effect of accumulation of heavy metals were evaluated in aqua culture.

KEYWORDS: Aqua culture, Heavy Metals, toxicity

I. INTRODUCTION

A .GENERAL

The metal which has a relatively high density and toxic at low quantity is referred as 'heavy metal', e.g., arsenic (As), lead (Pb), mercury (Hg), cadmium (Cd), chromium (Cr), thallium(Tl), etc. Some 'trace elements' are also known as heavy metals, e.g., copper (Cu), selenium (Se) and zinc (Zn). They are essential to maintain the body metabolism, but they are toxic at higher concentrations. The heavy metals can enter the bodies to a small extent via food, drinking water and air1. The heavy metals concerned with the environmental science chiefly include Pb, Hg, Cd, Cr, Cu, Zn, manganese (Mn), nickel (Ni), silver (Ag), etc At present, the pollution has become a serious threat, and has brought hazards to the growing population as well as the earth/environment. The speedy urbanization and industrialization has led to increased disposal of pollutants like heavy metals, radio nuclides, and various types of organic and inorganic substances into the environment. Thus, the industrial wastes are the main source of metal pollution for aquatic organisms. It has been cited that the heavy metals constitute the major pollutants in the environment. The heavy metals are important pollutants for fishes, because these are not eliminated from aquatic systems by natural methods, such as organic pollutants, and are enriched in mineral organic substances. The metal contaminants are mixed in the aquatic system through smelting process, effluents, sewage and leaching of garbage which cause severe harm to the aquatic system. Tannery industry has added pollutants to the aquatic environment. The tannery waste waters continue to cause hazardous effects on the aquatic organisms as they also have endocrine disruption effects. A large number of chemicals are being used by the tanners during process, and thus discharge the toxic materials into waters. Due to this, the agricultural lands are also degraded. Uncontrolled release of tannery effluents has increased the health risks to different organisms

The aquatic environment with its water quality is considered the main factor controlling the state of health and disease in both cultured and wild fishes. Pollution of the aquatic environment by inorganic and organic chemicals is a major factors posing serious threat to the survival of aquatic organisms including fish.Pollution of the aquatic environment by inorganic chemicals has been considered a major threat to the aquatic organisms including fishes. The agricultural drainage water containing pesticides and fertilizers and effluents of industrial activities and runoffs in addition to sewage effluents supply the water bodies and sediment with huge quantities of inorganic anions and heavy metals. The most anthropogenic sources of metals are industrial, petroleum contamination and sewage disposal.

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Metal ions can be incorporated into food chains and concentrated in aquatic organisms to a level that affects their physiological state. Of the effective pollutants are the heavy metals which have drastic environmental impact on all organisms. Trace metals such as Zn, Cu and Fe play a biochemical role in the life processes of all aquatic plants and animals; therefore, they are essential in the aquatic environment in trace amounts. In the Egyptian irrigation system, the main source of Cu and Pb are industrial wastes as well as algaecides (for Cu), while that of Cd is the phosphatic fertilizers used in crop farms.

II. LITERATURE REVIEW

The extensive literature review was carried out by referring standard journals and conference proceedings. The major work carried out by different researchers are summarized below.

Madhuri S [01] studied "Heavy Metals Causing Toxicity in Animals and Fishes" The heavy metals chiefly include Pb, Hg, Cd, Cr, Cu, Zn, Mn, Ni, Ag, etc. The heavy metals, viz., As, Cd, Pb and Hg are considered most toxic to humans, animals, fishes and environment. Excessive concentrations of heavy metals are detrimental.They destabilize ecosystems because of their bioaccumulation in organisms, and toxic effects on biota and even death in most living beings. All heavy metals, in spite some of them are essential micronutrients, have their toxic effects on living organisms via metabolic interference and mutagenesis. The bioaccumulation of toxic metals can occur in the body and food chain. So, the toxic metals generally exhibit chronic toxicity. The heavy metals like Pb and Hg have significant toxic effects. The heavy metals are important pollutants for fishes, because these are not eliminated from aquatic systems by natural methods, such as organic pollutants, and are enriched in mineral organic substances. Occurrence of heavy metals differs in fishes, depending on their age, development and other physiological factors. Among animal species, the fishes are inhabitants which can be highly affected by these toxic pollutants. Heavy metals can have toxic effects on different organs. They can enter into water via drainage, atmosphere, soil erosion and all human activities by different ways. As the heavy metals concentrated more in the environment, they enter biogeochemical cycle, leading to toxicity.

Khayatzadeh J et al [02] studied "The Effects of Heavy Metals on Aquatic Animals" Heavy metals consist less than one percent of living mass organisms, and their different density cause to some disorders. Surface waters and also acidic rains can transfer these metals to oceans via washing polluted environment. Heavy metals naturally exist in very little amount in watery places. Metals pollution of the sea is less than other types of watery pollution but its effects on marine ecosystems and humans are very extensive. Industrial wastes in aquiculture cause toxic effects in aquatic organisms specially in fishes. Aquatic organisms absorb the pollutants directly from water and indirectly from food chains. Some of the toxic effects of heavy metals on fishes and aquatic invertebrates are; reduction of the developmental growth, increase of developmental anomalies, reduction of fishes survival- especially at the beginning of exogenous feeding or even cause extinction of entire fishes population in polluted reservoirs. These consequences can affect on geological, hydrological and finally on biological cycles. Thus it seems that more consideration of bioconservation protocols are so important.

J. BalaChennaiaha,et al [03] studied "Concentration of Heavy Metals inDrinking Water with Emphasis onHuman Health" The study was undertaken to assess the status of drinking water quality in the rural areas of theBhongiri region, India. A total of 42 drinking water samples were collected from areas of the region, viz.:Ghatkesar, Pagidipalli, Bibinagar, and Bhongiri. All the samples were analysed for three physicochemicalparameters Such as Conductivity, Total dissolved solids (TDS), pH and Twelve heavy metals (As, Cd, Co, Cu, Cr,
Fe, Mn, Ni, Pb, V, Mo,Zn) and cations like (Na,K, Ca, mg)using standard procedures. The results were compared with other national and international standards. Among the analysed samples, regarding physicochemical parameters, 21% of the sample for hydrogen ion concentration (pH), 73.80 % of the sample for total dissolvedsolids (TDS) and 33% of the samples forelectrical conductivity (EC) concentrations higher than the WHO (2004) recommended values. All the Cations (Na, Mg, K, and Ca) concentrations exceeded the permissible limits of WHO and BIS. Regarding Heavy metals out of twelve Heavy metals six heavy metals (Cr, Fe, Mn, Ni, Pb, and Zn) concentrationsexceeded the WHO and BIS permissible limits, this could poses serious health diseases. It is recommended that potable water sources in the study area should be routinely monitored to ascertain its suitability for drinking and other purposes.The study was undertaken to assess the status of drinking water quality in the rural areas of the Bhongiri region, India. A total of 42

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Duruibe, J. O.et al [04] studied "Heavy metal pollution and human biotoxic effects" Some heavy metals have bio-importance as trace elements but, the biotoxic effects of many of them in human biochemistry are of great concern. Hence, there is the need for proper understanding of the conditions, such as the concentrations and oxidation states, which make them harmful, and how biotoxicity occurs. It is also important to know their sources, leaching processes, chemical conversions and their modes of deposition to pollute the environment, which essentially supports lives. Literature sources point to the fact that these metals are released into the environment by both natural and anthropogenic sources, especially mining and industrial activities, and automobile exhausts (for lead). They leach into underground waters, moving along water pathways and eventually depositing in the aquifer, or are washed away by run-off into surface waters thereby resulting in water and subsequently soil pollution. Poisoning and toxicity in animals occur frequently through exchange and co-ordination mechanisms. When ingested, they combine with the body's biomolecules, like proteins and enzymes to form stable biotoxic compounds, thereby mutilating their structures and hindering them from the bioreactions of their functions. This paper reviews certain heavy metals and their biotoxic effects on man and the mechanisms of their biochemical activities.

Darshan Malik et al [05] studied "Heavy Metal Pollution of the Yamuna River: An Introspection" The Yamuna river, which is the lifeline of Delhi, is one of the most-polluted river in the country. About 85 percent of the pollution is caused by domestic and industrial sources. The quality of the river is severely affected by the discharge of untreated domestic and industrial effluents. The water quality is not fit for bathing, underwater life and domestic supply. A wide range of contaminants are continuously introduced into the river and their toxicity is a problem of increasing significance for ecological, evolutionary, and environmental reasons. Among these contaminants, heavy metals due to their toxicity, accumulation and non-degradable nature, constitute one of the most dangerous groups. Heavy metals viz., Lead (Pb), Copper (Cu), Cadmium (Cd), Chromium (Cr), Zinc (Zn), Nickel (Ni) and Arsenic (As) have adverse effects on human metabolism and health. Bioaccumulation of the heavy metals may cause damage to the central nervous system, lungs, kidneys, liver, endocrine glands, and bones. The prevailing condition of the river is of serious concern, and there is an urgent need to take strict measures to ensure cleansing of the river and prevent further contamination.

III. EFFECT OF VARIOUS HEAVY METALS

For the assessment of water pollution status of the water bodies the following effects are identified :

A.Copper:
In humans, theCu is essentially needed but in high doses, anaemia, liver andkidney damage, and stomach and intestinal irritation may occur.During Wilson's disease, it affects greatly. It is normally foundin drinking water from Cu pipes and additives designed to control the algae growth.

B. Chromium:
The Cr has been reported to be used in metal alloys and pigments for paints, cement, paper, rubber and other materials. The low level Cr canirritate skin and can produce ulcer. Its chronic exposure can produce kidney and liver damage. The Cr can also damage to circulatory and nerve tissues. In aquatic animals, it is normally accumulated and can cause toxicity to eating fish.

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C. Nickel:
The Ni is needed in small amounts to produce red blood cells (RBCs), but it becomes slightly toxic in excess quantity. Its chronic exposure can cause decrease in body weight, heart and liver damage, and skin irritation. In aquatic animals, the Ni is accumulated but its presence is not magnified along the food chains.

D. Lead:
Exposure of Pb can cause many effects depending on level and duration of Pb. The developing foetus and infant are more sensitive than the adult. Mostly, the bulk of Pb is received from food; however,other sources may be more important like water in areas with Pb piping and plumb solvent water, air near point of source emissions, soil, dust and paint flakes in old houses or contaminated land. In air, the Pb levels are brought in food through deposition of dust and rain containing metal on crops and soil. Eight broad categories of Pb use are: batteries; petrol additives; rolled and extruded products; alloys; pigments and compounds; cable sheathing; shot; and ammunition. In environment, the Pb comes from both natural and anthropogenic sources. The Pb exposure can be through drinking water, food, air, soil and dust from old paint. The Pb is among the most
recycled non-ferrous metals, so its secondary production has grown steadily. The high levels of Pb may result in toxic effects in humans which in turn cause problems in the synthesis of haemoglobin (Hb), effects on kidneys, gastrointestinal tract (GIT), joints and reproductive system, and acute or chronic damage to nervous system.

E. Mercury:
The Hg is not present naturally in living organisms. It is a toxic substance with no known function in biochemistry or physiology. It has complex and unusual chemical and physical properties. Degassing of earth's crust, emissions from volcanoes and evaporation from natural bodies of water are the major natural sources of Hg. World-wide mining of metal leads to indirect discharges into atmosphere. The Hg is widely used in industrial processes and in different products (e.g., batteries, lamps and thermometers). It is also used in dentistry as an amalgam for fillings and in pharmaceutical industry. The Hg is mostly present in a relatively unreactive form as a gaseous element. The methylated forms of Hg are bioaccumulated over a millionfold and concentrated in living beings, especially fish. These forms of Hg (monomethyl Hg and dimethyl Hg) are highly toxic, causing neurotoxicological disorders. Inorganic Hg toxicity is associated with tremors, gingivitis and/or minor psychological changes, together with spontaneous abortion and congenital malformation in humans. Monomethyl Hg causes damage to brain and CNS, whilefoetal and postnatal exposures have given rise to abortion, congenital malformation and development changes in young children.

F. Cadmium:
The Cd derives its toxicological properties from its chemical similarity to Zn (an essential micronutrient for plants, animals and humans). The Cd once absorbed by an organism, present for many years (over decades for humans), though it is eventually excreted. It is produced as an inevitable by-product of Zn (or occasionally Pb) refining, since these metals occur naturally within the raw ore. But once collected, the Cd is relatively easy to recycle. The Cd is mostly used in Ni/Cd batteries, rechargeable or secondary power sources exhibiting high output, long life, low maintenance and high tolerance to physical and electrical stress. The coatings of Cd provide good corrosion resistance, particularly in high stress environments like marine and aerospace applications where high safety or reliability is required; the coating is preferentially corroded if damaged. It is also used as pigment, stabilizer for PVC, in alloys and electronic compounds. As an impurity, it is present in several products,including phosphate fertilizers, detergents and refined petroleum products. Average daily intake of Cd for humans is 0.15 µgfrom air and 1 µg from water. The Cd if exposed for long time may cause kidney dysfunction. Its high exposure may cause obstructive pulmonary disease and lung cancer. Bone defects (osteomalacia, osteoporosis) have also been reported in humans and animals. Besides, it can also cause increased blood pressure and myocardial disease in animals.

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Vol. 4, Issue 4 , April 2017

TABLE NO 1: EFFECTS OF HEAVY METALS ON HUMAN BEING

SR.NO	HEAVY METAL	EFFECT ON HUMAN BEING
1	Lead	Cognitive, Impairment InChildren, PeripheralNeuropathy In Adults,Developmental Delay
2	Copper	Headache, Nausea, Vomiting Diarrhea AndKidney Malfunctioning
3	Zinc	Vomiting, Diarrhea, Icterus, Liver And KidneyDamage
4	Nickel	Neurotoxic, Genotoxic, And CarcinogenicAgent, Nickel Dermatitis
5	Cadmium	Kidney And Liver Damage. Renal Dysfunction,Gastrointestinal Damage.
6	Chromium	Gastrointestinal,Hepatic, Renal,Neuronal Damage

IV. CONCLUSION

The heavy metals, viz., As, Cd, Pb and Hg are most toxic to all human beings, animals, fishes and environment. The excess levels of heavy metals cause severe toxicity. Though some heavy metals are essential for animals, plants and several other organisms, all heavy metals exhibit their toxic effects via metabolic interference and mutagenesis. The Pb and Hg cause severe toxicity in all. Fishes are not the exception and they may also be highly polluted with heavy metals, leading to serious problems and ill-effects. The heavy metals can have toxic effects on different organs. They can enter into water via drainage, atmosphere, soil erosion and all human activities by different ways. With increasing heavy metals in the environment, these elements enter the biogeochemical cycle.

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