

Effects of Heavy Metals on the Living Organism Near Agra Region



Prem Prabhakar
Department of Chemistry,
Paliwal P G College Shikohabad Firozabad,
Uttar Pradesh, India

ABSTRACT

The rapid industrialization and intensive agricultural activities over the last few decades have resulted in accumulation of various pollutants in the environment, which are distributed over wide areas by means of air and water. This has caused visible detrimental effects to the ecosystem and consequences to human health. The present study evaluates the concentration of heavy metals in different vegetables species around industrial area. Potential health risks of heavy metals to the local population via vegetables consumption were estimated. The health risks of lead (Pb), cadmium (Cd), zinc (Zn), mercury (Hg), arsenic (As), silver (Ag), chromium (Cr), copper (Cu), iron (Fe), and the platinum group elements have adverse effects on human metabolism and health. 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. 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.

Keywords : Heavy Metals, Environment, Toxicity, Contaminants, Bioaccumulation

I. INTRODUCTION

In the recent years, heavy metal toxicity has grown up as a serious concern all over the world, as these heavy metals pose adverse effects on all forms of living organisms in the biosphere. These heavy metals are not readily degradable in the environment and accumulate in the animal and human bodies to a very high toxic levels leading to undesirable effects. The increased population and the progress in agriculture

and industry, in the recent years, have further complicated this situation (1). The discharge of untreated or partially treated industrial waste waters containing heavy metals into the water bodies, especially rivers, prevail in aquatic bodies and get bioaccumulated along the food chain. Biomagnification of these heavy metals along the food chains occurs leading to various health hazards to both humans and other living organisms. River Yamuna also considered as prominent and sacred as

the great 'River Ganga' itself, is the leading branch of River Ganga. The key tributary of river originates from the Yamunotri glacier (Saptrishi Kund) near Bander punch peaks (380 59' N 78027'E) in the Mussoorie range of the lower Himalayas in Uttarkashi district of Uttaranchal and also commended as a 'sacred river'. Due to its soil fertility, Yamuna River basin is most widely used for agriculture production. Yamuna water after proper treatment is supplied for domestic activities and untreated water is used for various agricultural activities (2). Population density, Industrialization, Urbanization & agricultural activities in & around the Yamuna River region, have deteriorated the quality of Yamuna River to maximum extent that affects the aquatic biodiversity & impact on the public health also. Heavy metal pollution of agricultural soil and vegetables is one of the most severe ecological problems on a world scale and also in Agra. The food chain contamination is the major pathway of heavy metal exposure for humans. The consumption of vegetables is one of the most important pathways for trace metals that harm human health. The risks associated with the consumption of contaminated food grown near the industrial area may be a potential health concern (3). However, description on metal toxicity scarcely found in literature and related data are severely insufficient to accomplish the risk assessment. Health risks have been evaluated by numerous methods but most commonly, risk to the human health is computed in terms of Target hazard quotient (THQ) which is based on the concentration of trace metals in the edible parts of vegetables. Water plays vital role in human life. It is extremely essential for survival of all living organisms. Groundwater is ultimate, most suitable fresh water resource with nearly balanced concentration of the salts for human consumption. Over burden by means of population pressure, unplanned urbanization, unrestricted exploration policies and dumping of the polluted water at inappropriate place enhance, the infiltration of harmful compounds to the groundwater (4). The

quality of water is of vital concern for the mankind since it is directly linked with human welfare. The uncontrolled disposal of industrial and urban wastes and the use of chemical substances in agriculture (fertilizers, herbicides and pesticides) are the primary causes of groundwater contamination. Overpopulation causes increase in food demand and livestock products. To full fill ever-increasing demand of food, dairy product and essential need of population modernization of industry is imminent and causes use of excessive fertilizer in agricultural land due to which increase in environmental concentration of heavy metals in water, air and soil has taken place. Food chain contamination by heavy metals has become a major issue in recent years because of their potential accumulation in biosystems through contaminated water and soil (5). Due to large-scale production, consumption and lack of regulations, heavy metals are discharged into the environment in large quantities through waste water irrigation, solid waste disposal, sludge application, vehicular exhaust and atmospheric deposition. As a result, heavy metals are omnipresent in the industrial, municipal and urban runoff.

II. SOURCES AND EMISSIONS

Concentration of heavy metals are increased due to progress in agriculture and industry, in the recent years. . The discharge of untreated or partially treated industrial waste waters containing heavy metals into the water bodies, especially rivers, prevail in aquatic bodies and get bioaccumulated along the food chain. Most of the treated and untreated industrial effluents are being discharged to the river. Several acres of agricultural land irrigated by contaminated river water and farmers cultivate various types of vegetable crops of economic importance. Heavy metals are considered the most important form of pollution of the aquatic environment because of their toxicity and accumulation by marine organisms. The concentration of heavy metals in the fish from the River water has shown that the metal concentration found in the fish

samples were higher than the range of maximum acceptable limits as per WHO (4). The various industrial outlets which drain into the river is a probable source of the heavy metals in the Yamuna, leading to severe deleterious effect in humans, fish and plants.

III. BIOLOGICAL CONTAMINATION OF RIVER

YAMUNA- Although the Yamuna is polluted almost throughout its entire length in the plains. The organic pollution level increase significantly and the Biochemical Oxygen Demand (BOD) level do not confirm to the stipulated standard form. The same stretch of the river shows fluctuations in Dissolved Oxygen (DO) level from Nil to well above the saturation level. This reflects the presence of organic pollution load and prevalence of eutrophic conditions. Bacteriological contamination is significantly high in the entire Yamuna River stretch (6). The main sources of pollution in this region are:

- Rising density of human population on the river banks and poor sanitation practices by residents.
- Untreated domestic wastewater and untreated industrial effluents.
- Diffuse pollution (agricultural runoffs; dead body dumping and cattle washing) Undetected and untreated pesticide residues leave a toxic mark all across the river.
- Religious activity and immersion of idols.

IV. HEAVY METAL POLLUTION SOURCES OF RIVER YAMUNA

As a result of ecological stress created by humans on the aquatic environment, the pollution levels have significantly increased. Numerous studies have been conducted for testing the presence of heavy metals in the river Yamuna. In a study for determination of heavy metals in fish species, characterization of heavy metals in fish elucidated that the concentrations of Ca, K, Mg, Na and P were too high as compared with

other metal and were not in the maximum permissible level set by World Health Organization (WHO). Industrial discharge, release of organic material into water, domestic waste etc. have caused a reduction in oxygen level and are a major reason for eutrophication. The pollution of the aquatic environment with heavy metals has become a worldwide problem during recent years, because they are indestructible and most of them have toxic effects on organisms (7). Among environmental pollutants, metals are of particular concern, due to their potential toxic effect and ability to bioaccumulate in aquatic ecosystems. Heavy metals are considered the most important form of pollution of the aquatic environment because of their toxicity and accumulation by marine organisms. The concentration of heavy metals in the fish from the River water has shown that the metal concentration found in the fish samples were higher than the range of maximum acceptable limits as per WHO. The various industrial outlets which drain into the river is a probable source of the heavy metals in the Yamuna, leading to severe deleterious effects in humans, fish and plants.

V. EFFECT OF HEAVY METALS ON HUMAN

HEALTH- Heavy metals have been shown to mainly enter the human body through food and water and are known to have serious health implications. Various heavy metals detected in the environment and their effect on human health.

Lead (Pb): Lead is ubiquitously present heavy metal which is used in paints, storage batteries, and the oxide is used in producing fine crystal glass. Higher levels of Pb lead to cognitive impairment in children to peripheral neuropathy in adults. Lead is physiological and neurological poisonous to human. Severe Pb poison might outcome in a dysfunction in the kidney, reproduction system, liver and brain resultant in illness and death. Pb head the intimidation still at tremendously little concentration. A particularly grave cause of lead toxicity is its

teratogenic cause. Lead poison also cause reserve of the mixture of hemoglobin; cardiovascular system and acute and chronic harm to the central nervous system (CNS) and peripheral nervous system (PNS). Additional unceasing effect comprise anemia, fatigue, gastrointestinal harms and anoxia. Lead can cause difficulty in pregnancy, high blood pressure, muscle and joint pain. In the adult inhabitants, reproductive effect, such as decreased sperm counts in men and impulsive abortions in women have been connected with high lead exposure (8). Severe contact to lead induce brain damage, kidney damage, and gastrointestinal diseases.

Copper (Cu): Copper is used in electroplating industries situated on the banks of the rivers. When present at low concentrations, Cu causes headache, nausea, vomiting and diarrhea, and at higher levels of deposition, it leads to liver and kidney malfunctioning.

Zinc (Zn): Zinc is discharged in the rivers in the form of effluents from electroplating industries, sewage discharge and the immersion of painted idols. Zinc toxicity causes vomiting, diarrhea, icterus, liver and kidney damage. Different study have suggested that zinc inhalation and drinking contaminated water might cause signs of gastrointestinal diseases or modification in gastrointestinal soft tissue (9). Zinc plays a main part the usual increase and preservation of the immune structure, such as in the lymphocyte reaction to mitogens and as a cofactor for the thymic hormone thymulin. Actual restricted in sequence advice that overdoses oral intake of zinc can origin slight neuron fall down and modify of emission of the hypothalamus in rats.

Nickel (Ni): Nickel is discharged into the rivers by industries like Stainless steel manufacturing units, electroplating factory discharge. Ni is neurotoxic, genotoxic, and carcinogenic agent which may cause health problems like nickel dermatitis etc. Individual nickel disclosure originate since a variety of source and is extremely variable. Nickel is generally current in human tissues and, beneath circumstances of elevated disclosure, these level might enhance a lot.

Foodstuff intake, gastric emptying and peristalsis of the intestine are of substantial impact for the bioavailability of nickel, since absorption of ingested nickel is minor while it is administrate in food or in water simultaneously through a meal. Nickel compound have be well recognized as carcinogenic in lots of animal species and by numerous modes of human exposure but their essential mechanisms are still not fully understood (10). Nickel hypersensitivity also cause asthma, conjunctivitis, inflammatory reaction to nickel-containing prostheses and implant, and systemic reactions after parenteral administration of nickel-contaminated fluids and medications. The sensitivity to nickel would emphasize the need to monitor nickel contented in intake water and nickel-allergic subjects must be alert of the augmented assimilation while drinking water on an empty stomach.

Cadmium (Cd): Cadmium is produced by several industrial processes such as protective coatings (electroplating) for metals like iron, preparation of Cd-Ni batteries, control rods and shields within nuclear reactors and television phosphors. Cd when partaken over a long period of time leads to its bioaccumulation in the kidney and liver and causes severe damage. Cadmium is a well recognized heavy metal toxicant through a precise gravity 8.65 times greater than water. The aim organs for Cd toxicity have been recognized as liver, placenta, kidneys, lungs, brain and bones (11). Depending on the harshness of contact, the symptom of effect includes nausea, vomiting, abdominal cramps, dyspnea and muscular weakness. Harsh contact might result in pulmonary edema and death. Pulmonary effect (emphysema, bronchiolitis and alveolitis) and renal effect might happen follow sub chronic in halation contact to cadmium and its compound. Following severe intake, symptom such as abdominal pain, burning sensation, nausea, vomiting, salivation, muscle cramps, vertigo, shock, loss of consciousness and convulsion typically emerge inside 15 to 30 min. Acute cadmium intake can also reason gastrointestinal tract erosion,

pulmonary, hepatic or renal injury and coma, depending on the route of poisoning.

Chromium (Cr): Chromium present in the Yamuna river is attributed to electroplating industries situated near the banks of the river. Ingestion of large amounts of Cr also has severe detrimental health effects like gastrointestinal, hepatic and renal damage.

VI. CONCLUSION

The occurrence as well as concentrations of heavy metals in streams and rivers all over the world is increasing. In the present case study, heavy metal contamination was consistently higher in city of Agra, which may be attributed to the heavy industrialization combined with agricultural and urban runoff. The situation is made worse by atmospheric deposition, again attributable to industrial and vehicular pollution. In general, freshwater ecosystems have low natural background metal levels and therefore tend to be sensitive to even small additions of most trace metals.

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