Review Article

ENVIRONMENTAL TOXICOLOGY

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ABSTRACT

Medicines are prescribed for a range of illnesses and occasionally used for a variety of nonmedical purposes. There are countless documented cases where medications have caused more harm than good. Concerns over the environmental effects of medication manufacture are also becoming more widespread among scientists and environmentalists. Low concentrations of medications have been found in drinking water, ground water, surface water, sea water, and sewage treatment plant (STP) effluents in numerous nations. Acute toxicity tests have been used to examine the effects of certain medications on aquatic species. However, little is known about the long-term toxicity and possible mild consequences.[1]

KEYWORDS

Toxicology, agriculture, environment, heavy metals, ecotoxicology.

INTRODUCTION

These days, thousands of contaminants enter aquatic habitats, straining aquatic life in a number of ways that often result in harmful changes to the quality of the water. The aquatic life is still one of the ecosystem's most important components. The detrimental impacts of chemical pollution are becoming better understood as more studies are conducted on these contaminants and as analytical detection techniques develop. The aquatic environment, an essential component of the biosphere, has been called “the ultimate sink” for both naturally occurring and man-made toxins. With the limited amount of water available, ongoing chemical pollution of the aquatic ecosystem could pose a major harm to the environment's health. [2] The environment is defined as the place where microorganisms exist or operate. It is composed of Earth's atmosphere, land, and water. The four zones that make up the Earth's system are the environment (air), ecosystem (living things), water layer (water), and crust (land). All of these regions work together. More substances than in any other area of our surroundings are contaminants and environmental pollutants.

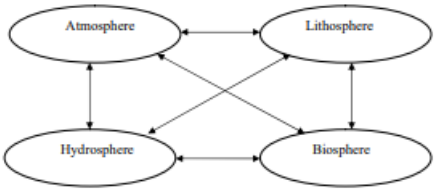

Fig. No. 1: Relationship of all the spheres

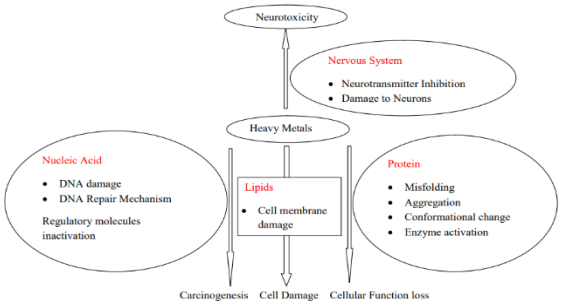

Table No. 1: List of heavy metals that are more prevalent in daily life and have densities greater than 5 g/cm3.

Fig. No. 2: Effects of heavy metal contamination

The interdependence of people, animals, and plants in our habitat is recognized by several cross-disciplinary medical practices, such as eco-health and healthcare of the Earth. Regrettably, anthropogenic production and consumption habits have created global change agents that have altered the health-related relationship by resulting in unparalleled biodiversity losses. For example, the current decrease rate is 10–100 times higher than it was during the previous 10,000 years, putting over a million species at risk of going extinct in the next few decades. [4]

ENVIRONMENTAL CONTAMINANTS

Tributyltin (TBT), an environmental pollutant with potent biocidal qualities, is found on every continent except Antarctica. Organotin compounds are tin compounds based on hydrocarbons. These materials are used as antifungals, molluscicides, and acaricides in agriculture and industry, as well as repellent paints and wood preservatives. Tributyltin (TBT) is a general word for a class of compounds that are characterized by their poor water solubility and involvement in the (C4H9)3Sn category. Tributyltin oxide is a well-known method for preparing TBT. TBT's low cost and potent antifouling paint-preventing properties made it a popular additive for ship hulls and underwater marine equipment by the middle of the 1960s.

TBT started to harm aquatic species in the marine environment after years of extensive use, and its

detrimental effects were subsequently documented. For example, populations of the invertebrate Nucelli lapillus along the UK coast have demonstrated that imposex, or the emergence of masculine sexual features in women, can be caused by a low dosage of 1 ng/L.

Vertebrates have also been reported to exhibit the Imposex effect. According to initial documentation of imposex with mammals, females might be masculinized by consuming amounts of TBT in their food of 0.1 µg/g, which is what Paralichthys olivaceus ate. More than 260 species of marine gastropods have been reported to exhibit the imposex effect of TBT as of 2011.

Heavy Metals	Occurrence of Source	Effects on human health
Nickel	Air, water, soil, food	Lung fibrosis, kidney & cardiovascular diseases, Cancer of respiratory tract.
Cadmium	Electroplating, pesticides, fertilizers	Renal dysfunction, bone defects, kidney damage, bone marrow.
Lead	Burning of coal, Automobile emissions, smoking	Mental retardation in children, chronic damage to nervous system
Arsenic	Pesticides, fungicides, mental smelters	Bronchitis, dermatitis, poisoning
Zinc	Mental plating, Refineries	Damage to nervous system, dermatitis

Furthermore, economic losses and environmental harm had already extended to other continents by this point. Several restrictions against the use of TBT in antifouling paints were first put into place in France, the UK, and other nations. Two factors that can increase the half-life of TBT compounds in the surrounding environment are their ability to dissolve in lipids and their preferential absorption through sludge or biological material with environments, which makes them suitable for placement in ocean sediments, and their ability to be distributed up to a century into the atmosphere, as predicted by computational frameworks.

Furthermore, TBT bioaccumulates in a variety of marine creatures those are at the base of the food chain. Due to their lipid solubility, TBT remains in these organisms even 20 years after the initial contamination. Marine life, fish, and seabirds because of the biomagnification of the contamination that occurs inside the nutritional connection, mammals may carry TBT residues. The World Health Organization (WHO) set a daily threshold of 250 ng/Kg of TBT due to the possible harm that consuming polluted food or water (such shellfish) can cause to human health. A 100-fold extrapolation was used to determine its significance based on tests for toxicity, mobility, and individual variation in mice. According to these experiments, the animals' thymus weight and function were reduced when TBT was added to their diet. The main way that drinking contaminated water or other beverages exposes people to TBT. However, eating seafood in particular has been demonstrated to be a significant human exposure pathway. The highest TBT concentration (1510 ng g^3 dry weight) was found in oysters from the coastal region of Hsiangshan, which accounted for 86–91 percent of all butyltin compounds in developed countries in the 1980s. A few years later, the International Maritime Organization (IMO) forbade the use of TBT-containing antifouling paints worldwide on January 1, 2003, and on January 1, 2008, it outlawed their use on board ships. However, given the financial benefits, it was projected in 2004 that 70–80% of the world's naval fleet was made up of a combination of TBT.

Two factors that can increase the half-life of TBT compounds in the environment are their ability to fall into sediments from the ocean (due to their notable solubility in lipids and preferential absorption by sand or biological material in environments) and the fact that they can be allowed to linger in the environment for up to a century, as predicted by mathematical methods. Moreover, an abundance of studies has shown that TBT disrupts estrogen signaling, affecting several tissues. [5]

APPLICATIONS

1)Use of Pharmaceutical Concept in Environment Dosage:

Environmental exposure to pesticides every year, a lot of chemicals (primarily herbicides, insecticides, and fungicides) are applied to arable areas. Initially, a seed coating is sprayed to protect freshly sprouting crops against target pest A. A significant amount of pesticide seeps into the soil, exposing it to helpful soil organisms including mycorhhizal fungus and earthworms. Within field boundaries (wildflower/hedgerow), where native plant species and other organisms may be at risk, pesticides disperse by water, mud, or breeze. Through nectar

and pollen, a contaminated crop may also expose pollinators to pesticides over an extended period of time.
This seeming conflict could be explained by three factors:
1)There is no harm to biodiversity by pesticides
2)The problem is pesticides, but they've started an irreversible chain reaction.
3)The total number of pesticides used

Considering an ecosystem to be a single living thing black arrows represent therapeutic actions, while red arrows suggest possible unintentional actions.
1)The person: While an individual arrives with a health concern, issue, the clinician is guided by fundamental pharmacological principles to administer the least amount of treatment that will be both minimally effective and safe for the patient. According to environmental pharmacology, regional ecology must view since one of them system of life that is comparable for a sufferer.
2)Handling: The analogy starts via a warning, which could be an agricultural pest within an ecosystem or a disease that affects humans. In both situations, a suitable dosage schedule (Chemical burden while dosage frequency) must deliver a bioactive steady-state dose in order for the drug to be used effectively (To individual) or pesticide (Regarding an agricultural product).
3)Side effects: treatment should only be administered in proportion to acceptable side effects arising from off-target bioactivity (e.g., human organ function or the activity of beneficial species in the ecosystem, like bees).
4)Long-term adaptations: In cases where chronic exposure arises (due to extended treatment or long-term persistence), human and ecological adaptations (such as pursuing choices/sensitization in harvest insects' ability to resist pesticides along with pollinators) must be taken into account. Examples of these adaptations include physiological consequences like addiction or sensitization, or multidrug resistance in pathogens.
5)Cocktail effects: a growing number of elderly patients are being treated for complex contraindications as a result of accumulating prescription medications, a condition known as polypharmacy.[6]

2)**When Used Pesticide Bioactivity Is A More Reliable Measurement of Possible Damage Compared To Weight:**

Refocusing regarding pesticide Bioavailability would allow pharmacology's full quantitative power to be applied, leading to a significant improvement in our comprehension of the danger posed by ecological pollutants and better environmental dosage for combating agricultural pests. For instance, the "therapeutic window," or the dosage range where a drug is present to provide a positive outcome, yet not one that side impacts exceed advantages, is a key idea in medical pharmacology. Low selectivity between related species is a common feature of pesticides. As a result, an insecticide might not be able to tell the difference between a pest like aphids and a beneficial insect like bumblebees, or during their a "weed" and an untamed, or between a fungicide and beneficial soil mycorrhizal fungus that cause fungal diseases in crops.
Therefore, the effects of pesticides on numerous organisms that observe without acting, whether toxicological or pharmacological (i.e., Dosage below dangerous threshold), are not regularly evaluated, despite the fact that the effects on the intended organisms could be well-researched.
When considering effectiveness of pesticides upon different pest species and the environmental impact of their use, the quantity of pesticides used appears to be a meaningless metric. It has been suggested that a more accurate way to gauge toxicity would be to use an agent's lethal dose (LDso), which is the dose at which 50% of treated subjects die. When measuring honeybee vulnerability using this metric, UK pesticide use increased sixfold between 1990 and 2015 instead of decreasing. Even though using LD5o as a metric is likely more beneficial than using pesticides in large quantities, it still misses sub lethal effects like behavioural changes that may have an impact on a species' long-term health.

FACTORS TO BE TAKEN INTO ACCOUNT REGARDING THE MEDICINAL PROPERTIES OF CHEMICALS IN NATURE INCLUDE:

1.Quantity & regularity.
2.The application of a varying makeup of chemicals cocktails. Each chemical's and its metabolite's unique environmental half-life.
3.The fluctuating effects regarding the numerous organisms that observe without acting, alternatively Pharmacological or toxicological (i.e., in dosages below lethal).
4.Variations in sensitivity at various phases of development.
5.The fluctuating impact of confusing surroundings regarding observer organisms: climate, soil type, ecosystems calibre, runoff, and prevalence of disease and parasites. [7]

REFERENCES

1)Syed Ziaur Rahman, "Environmental pharmacology: A new discipline" Indian Journal of pharmacology, Vol 38, issue 4, Page NO 229-230.
2)Zhi-Hua Li, kaiyu He Ping Li, chunsheng Liu, "Aquatic Environmental Health and Toxicology,

Hindawi Publishing corporation BioMed Research V01 2016, Page No 1-2.
3)Jessica Briffa, Emmanuel Sinagra, Renald Blundell, "Heavy metal pollution in the environment & their toxicological effect on humans", Heliyon, Vol 6, issue 9.
4)Abigail N. Henke, Srikhar chilukuri, Laura M. Langan, Bryan W. Brooks," Reporting & Reproducibility: Proteomics of fish models in environmental toxicology and ecotoxicology Science of the Total Environment", 2023, vol 912.
5)Paul B. Tchounwou, "Environment Toxicology", Vol -38.
6)Ricardo correia da Silva, Mariana Pires Teixeira, Luciana Souza de Paiva& Leandro Miranda – Alves, "Environmental Health and Toxicology: Immunomodulation Promoted by Endocrine – Disrupting Chemical Tributyltin,Toxics, 2023.
7)Christopher N. Connolly, Stephen P. H Alexander, Jamie A Davies, Michael Spedding," Environmental pharmacology- Dosing the environment" British Pharmacological Society, Page NO-5172- 5179.