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PESTICIDE CONTAMINATION IN THE WATER OF RIVER YAMUNA (IN SPECIAL REFERENCE TO AGRA U.P.)

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Abstract

Water pollutants may include pesticides like γ-HCH, Endosulfan-α, chlorpyrifos, aldrin, heptachlor and DDT in Yamuna river water. The major pesticide and insecticide pollutants of water bodies are disposed into the river from industrial and municipal sewage discharges. The main Organic Pollutants are - Detergents, Pesticides, Chlorinated solvents, Drug pollution involving pharmaceutical drugs. The highest TDS in the water sample was observed as 2417 mg/L and five pesticides were traced in the water of river Yamuna , where, γHCH to range from ND to 0.0643 µg/L, Chlorpyrifos concentration ranged from ND to 0.124 µg/L, Endosulfan-α concentration ranged from ND to 0.142 µg/L, Aldrin concentration ranged from ND to 0.018 µg/L, Heptachlor concentration was found to be ranged from ND to 0.026 µg/L, and DDT concentration was found to be ranged from ND to 0.028 µg/L, however, Observed concentration of these pesticides were within the permissible limit (2 µg/L for γ-HCH, 0.4 µg/L for Endosulfan-α, 30 µg/L for chlorpyrifos, 0.03 µg/L for aldrin, 0.03 µg/L for heptachlor and 2 µg/L for DDT) set by BIS, 2012 for drinking water.

Keywords: *Pesticide, Residues, Endosulfan-α, Physico-chemical characteristics.*

Objective: To assess Pesticide residues in water samples collected from river Yamuna at Agra City Uttar Pradesh.

Apparatus: BOD Bottle (300mL)

Reagents- Manganese sulfate solution: Added 400g MnSO4.2H2O in distilled water and madeup to 1000 mL using distilled water, Alkali iodide-azide reagent: Added 500g sodium

hydroxide and 135g sodium iodide, distilled water and made-up to 1000 mL using distilled water. Sulphuric acid (H2SO4): 1 mL is corresponding to nearly 3 mL alkali-iodide-azide.

Starch indicator: Dissolved 2g of starch powder and 0.2g salicylic acid as a preservative in distilled water (100 mL). Stock sodium thiosulphate, 0.1N: Added 24.82g Na2S2O3.5H2O in distilled water and made-up to 1000 mL using distilled water. Further, conserved by the addition of 0.4g solid NaOH. Standard sodium thiosulphate, 0.025N: Diluted 250mL stock Na2S2O3 solution in distilled water and made-up to 1000 mL using distilled water. It was standardized before taking it into use.

Procedure: The evaporating dish was ignited in a muffle furnace at 550°C for 1 hour and then kept for cooling in a desiccator before taking weight (W1) The homogenized sample was passed through the membrane filter for filtration under a vacuum environment. 100 mL of filtered sample was taken in the weighed (W1) evaporating dish and then was dried by evaporating in oven at 180 ±2°C for 1 hour. After evaporation, the sample was kept for cooling in a desiccator. Same steps were repeated till weight stable. Lastly, the reading of the final weight (W2) was recorded.

Preparation of Sample (Pesticide residues) for GC-MS/MS:

Taken 1-liter water sample in a 2.0-liter separating funnel. Added 50g of sodium chloride & shake to dissolve salt. Added 100 mL of methylene chloride & extract the sample for 10 minutes. Transferred the organic layer through sodium sulphate into a round bottom flask. Again added 100 mL methylene chloride & extract. Repeated as per above twice. Collected the organic layer into a spherical bottom flask. Evaporated to extract up to 2-5 mL and transferred in the test tube. Extracted dry under nitrogen till up to dryness. Reconstituted 0.25 mL with hexane and injected on GC-MS/MS.

Discussion and Results:

Water is polluted exaggeratedly by overexploitation of the resources, industrialization, domestic sewage and innumerable human activities, run-off from land and hills; and these pollutants eventually find their way into the food web and affecting the ecosystems in the process. The fast industrialization causes an adverse effect on the environment directly and indirectly. Anthropogenic and industrialization related activities have greatly affected the environment through the generation of toxic substances. In the case of India, the water pollution crisis has

been in part due to non-systematic activities in agricultural farming, urban development, and industrialization.

Pesticides contribute greatly to agriculture to resolve the issues of meeting food requirements of the ever-growing population of the world (Villarreal-Chiu et al., 2017). However, they may enter aquatic ecosystems through different ways such as direct use (aerial spraying), runoff and soil erosion from agricultural areas, and release of domestic and industrial waste. In the aquatic system, these pesticides may cause serious toxicity problems to non-target organisms including fish and animals as a result of biomagnification via the food chain (Singh and Singh, 2008). Endosulfan belongs to the family of polycyclic chlorinated hydrocarbon organochlorine insecticide that has been in use for more than 30 years in agriculture, horticulture, and forestry. It has two stereoisomers i.e. α- and β-endosulfan in the ratio 3:7. Endosulfan pollution and perseverance in water and soil environments causes it to be accumulated in plants and fishes and persist for 3 to 6 months or longer (Goswami and Singh, 2009a). It is an off-patent banned insecticide and acaricide that is in the process of being phased out worldwide. Endosulfan can be oxidized to endosulfan sulphate which has extra oxygen attached to the S atom; and it became a contentious insecticide due to its severe toxicity, bioaccumulation possibility, and character as an endocrine disruptor, reproductive disorders, and cancer in humans and animals. A worldwide ban on production and usage of endosulfan was discussed under the Stockholm Convention in April 2011 due to its threats to humans and the environment. India was one of the largest manufacturer and users of endosulfan globally and has since the end of 2011 banned its use permanently. The results of the present study showed that the concentrations of endosulfanα were found to be much lower than the BIS limit of 0.4 µg/L for drinking water. During the study, The highest TDS in the water sample was observed as 2417 mg/L and five pesticides were traced in the water of river Yamuna , where, γHCH to range from ND to 0.0643 µg/L, Chlorpyrifos concentration ranged from ND to 0.124 µg/L, Endosulfan-α concentration ranged from ND to 0.142 µg/L, Aldrin concentration ranged from ND to 0.018 µg/L, Heptachlor concentration was found to be ranged from ND to 0.026 µg/L, and DDT concentration was found to be ranged from ND to 0.028 µg/L, however, Observed concentration of these pesticides were within the permissible limit (2 µg/L for γ-HCH, 0.4 µg/L for Endosulfan-α, 30 µg/L for chlorpyrifos, 0.03 µg/L for aldrin, 0.03 µg/L for heptachlor and 2 µg/L for DDT) set by BIS, 2012 for drinking

water. Based on the ANOVA study, we reached similar conclusions. It was noted that the various physico-chemical parameters concentration was found varying with the changes in the seasons and sampling sites. The domestic wastewater, sewage effluent, and agricultural run-off were expected to be the main source of pollutants in the Yamuna river water. Seasons and anthropogenic activities were also crucial factors to influence the variation in concentration of water quality parameters. Studying the results, it has been concluded that the existing condition of Yamuna river is so bad and not safe for useful purposes and so it requires the immediate

National and International specification for drinking water

PARAMETERS	UNIT	BIS	WHO	USEPA	EU	CHINA	CANADA
DDT	µg/L	1	2	-	0.10	-	-
Y-HCH (Lindane)	µg/L	2	2	0.2	0.10	-	-
β-HCH	µg/L	0.04	-	-	0.10	-	-
α-HCH	µg/L	0.01	-	-	0.10	-	-
δ-HCH	µg/L	0.04	-	-	0.10	-	-
Endosulfan – Alpha, Beta, Sulphate	µg/L	0.4	-	-	0.10	-	-
Monocrotophos	µg/L	1	-	-	0.10	-	-
Ethion	µg/L	3	-	-	0.10	-	-
Chlorpyrifos	µg/L	30	-	-	0.10	-	90
Phorate	µg/L	2			0.10	-	2
2,4-D	µg/L	30	30	70	0.10	-	100
Butachlor	µg/L	125	-	-	0.10	-	-
Isoproturon	µg/L	9	9	-	0.10	-	-
Alachlor	µg/L	20	20	2	0.10	-	-
Atrazine	µg/L	2	2	3	0.10	-	5
Methyl Parathion	µg/L	0.3	-	-	0.10	-	-
Malathion	µg/L	190	-	-	0.10	-	190
Aldrin and dieldrin	µg/L	0.03	0.03	-	0.10	-	-
Heptachlor	µg/L	-	0.03	0.4	0.10	-	-

attention for some strict actions to minimize its pollutants. This study suggested the potential use of Yamuna river water for irrigation after proper treatment specifically after proper biological treatment by using potent bacterial consortium to minimize the chemical load from the environment.

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