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Determination of Heavy Metals and Pesticides in potable water supply of Delhi, India.

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ABSTRACT

Delhi, the capital city of India is one of the most populated and industrialized cities in the world. This city is subjected to fast immigration and therefore experiences great anthropogenic pressure. Water pollution is posing a serious problem in Delhi and the causes are attributed to the negative effects of urbanization, industrialization and poor disposal of domestic wastes, industrial wastes and agricultural run offs'. The unthoughtful behaviour of humans has lead to environmental pollution. Some pollutants may spread through various channels and end up in polluting our surface and underground sources of water. Heavy metals and pesticides pollution poses a major threat to our environment presently. The objective of the study was to investigate the occurrence of heavy metals namely Mercury (Hg), Cadmium (Cd), Zinc (Zn), Arsenic (As) and pesticides namely : Chlorobenzilate, Hexachloro-benzene, Benzene ether, pp-DDT, op-DDT, pp-DDE, pp-DDD, alpha-HCH, Beta-HCH, Lindane, Vinclozolin, Conumaphos, Malathion, Phosalone, Cyfluthrin, Cypermethrin, Deltamethrin, Permethrin, Fenvalerate, Fluvalinate, Cyhalothrin, Carbofurn, Propoxeur, Carbaryl, Cymiazol, Amitraz, Bromprophylate, Chinomethionate in the potable water samples collected from various areas of Delhi.

Keywords: Potable Water, Pesticides, Heavy Metals, Anthropogenic Pressure, Delhi Metro.

INTRODUCTION

According to Food and Agriculture Organization (FAO) "Any substance or mixture of substances intended for preventing, destroying or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals causing harm during or otherwise interfering with the production, processing, storage, transport or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or substances which may be administered to animals for the control of insects, arachnids or other pests in or on their bodies. The term includes substances intended for use as a plant growth regulator, defoliant, desiccant or agent for thinning fruit or preventing the premature fall of fruit. Also used as substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport"[1].

Pesticides are categorized into four main subsistent chemical : herbicides, fungicides, insecticides and bacteriocides[2]. Pesticides occupy a unique position among chemicals found in drinking water since they

are deliberately used to control pests in agriculture. They comprise of variety of compounds having various chemical properties, toxic potential and mechanism of action[3].

Drinking water comes from two main sources: surface water (lakes, rivers or other fresh water sources) or ground water (aquifers). Human activities are responsible for infusing pesticides into drinking water system. Pesticides that are applied on crops may be washed away from application site by rain, before the pesticides binds or degrades, it is carried to surface water sources or may seep deep into the soil during recharge and get into aquifers. Pesticides are sometimes directly applied on lakes and wetlands for the control of aquatic weeds, insects or fish. Sometimes pesticides can move in air from application site to surface waters. Pesticides can get into drinking water when humans dump unused pesticides down the drain. In water treatment plants, antimicrobial pesticides are added during water treatment to prevent water borne diseases. Chlorine being one of them which can produce chemical by-products which may have toxic effects on humans. Pesticides used in the recharge zone (drinking water source in agricultural area where pesticides are sprayed or crops) might be found in drinking water. Pesticides which are soluble in water are more likely to be found in water[4-6]. About 5 million people die every year due to diseases caused by drinking impure water and incidence of water pollution due to heavy metals has reached an alarming level that environmentalists are finding it difficult to enforce control measures[7].

The term heavy metals refers to any metallic element that has relatively high density. Pollution of heavy metals may arise due to purification of metals, burning of fossil fuels, electroplating, preparation of nuclear fuels etc[8]. The non essential heavy metals have a direct or an indirect effect on the biological activities of humans. The presence of these metals degrades the quality of potable water which in turn affects human health. Even the essential metals at higher concentration can have toxic effects on human health. Due to intensive industrial and agricultural practices taking place in and around Delhi, it is likely that various heavy metals and pesticides are used and there are chances that they might have reached our drinking water sources and are persistent in our drinking water system. So, it becomes imperative to detect the presence of pesticides and heavy metals in potable water as it is of utmost concern to human health.

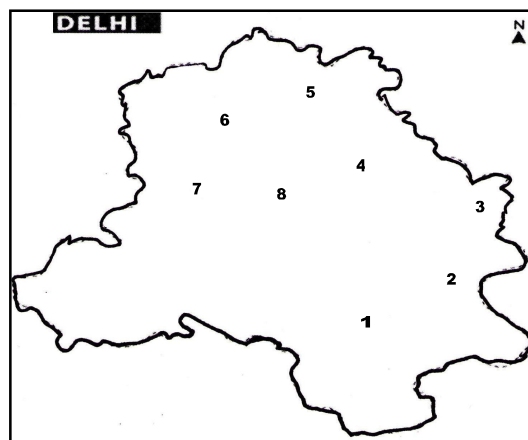
MATERIALS AND METHODS

A study was undertaken from October 2010 to October 2011 and 104 potable water samples were analyzed to obtain monthly variations in the quantity of heavy metals and pesticides at all study sites. The study sites were chosen to give representation of all areas.

Location of study sites with map: Location of study sites with map is shown in Figure 1

It is located at 28°37'N 77°14'E 28.61°N 77.23°E.

- Location 1 : Preet Vihar.
- Location 2 : Bajan Pura.
- Location 3 : Dilshad Garden.
- Location 4 : GTB Hospital.
- Location 5 : Vivek Vihar.
- Location 6 : Okhla Industrial Estate
- Location 7 : University of Delhi.
- Location 8 : Yamuna Vihar.



Sampling: Sampling for water analysis was done aseptically Figure 1. Location of Study Sitesrnal contamination of samples. For analysis, sterilized plastic bottles were used which were sterilized by boiling for 15 minutes and rinsed with distilled water. Effectiveness of sterilization was checked with each

run by using sterilization strips (commercially available) inside sampling bottles. During sample collection, some air space was left in the bottle to facilitate mixing by shaking, before examination. Tap is open fully and water was allowed to run for 2-3 minutes and then flow of water was reduced to permit filling of water samples.

Sample Analysis: Heavy metals were determined in drinking water samples using a Inductively Coupled Plasma Mass Spectrometer. (ICPMS, Agilent 7500 series) Pesticides were detected in drinking water samples by Gas Chromatography Mass Spectrometer (GCMS) Thermo Finnegan.

RESULTS AND DISCUSSION

Pesticides: Pesticides in potable water can cause a variety of adverse health effects. They can cause acute and delayed health effects to those who are exposed to them. These effects may range from irritation of eyes and skin, more severe effects such as affecting the nervous system, hormonal imbalance, birth defects, fetus deaths or cancer in many cases[7]. Individual pesticides might have toxic effect on humans. Variation exists in the toxicity of pesticides and the sensitivity of people to chemicals. Most pesticides will have toxic effects on animals at high levels, some parasites are toxic at medium or low levels. Pesticides in drinking water are usually found at very low levels.

All 104 drinking water samples collected from all the sites throughout the year were investigated for the occurrence and content of pesticides viz. : Chlorobenzilate, Hexachloro-benzene, Benzenether, pp-DDT, op-DDT, pp-DDE, pp-DDD, alpha-HCH, Beta-HCH, Lindane, Vinclozolin, Conumaphos, Malathion, Phosalone, Cyfluthrin, Cypermethrin, Deltamethrin, Permethrin, Fenvalerate, Fluvalinate, Cyhalothrin, Carbofurn, Propoxeur, Carbaryl, Cymiazol, Amitraz, Bromprophylate, Chinomethionate. However, no drinking water samples tested negative for the presence of any of these pesticides i.e. no pesticides were present in the samples of potable water.

Drinking water samples collected from various areas of Delhi did not contain any pesticides.

Heavy Metals: The monthly variations in the quantity of heavy metals studied at all sites are presented in Tables 1 to 8 from October 2010 to October 2011 along with quantitative report graph as obtained from ICPMS.

Lead: The major health effects of Lead are manifested in three organ systems; the hematological system, the central nervous system and the renal system[8].

The minimum and maximum value of lead in the water samples collected from different areas of Delhi are as follows:

Site 1 : 0.0009mg L⁻¹ (April 2011) to
0.01 mg L⁻¹ (August 2011)

the level of lead in drinking water samples ranged between 0.0009 mg L⁻¹ to 0.01 mg L⁻¹. Drinking water samples contained lead within permissible BIS (0.05 mg L⁻¹) limits. However, WHO guidelines suggest 0.01 mg L⁻¹ as the permissible limits for the presence of lead in drinking water

Cadmium (Cd) : In humans long term exposure Cadmium is associated with renal dysfunction. High exposure can lead to obstructive lung disease and has been linked with lung cancer in many cases. High cadmium intake may also produce bone defects like osteomalacic and osteoporosis in humans[9]. The minimum and maximum value of cadmium in the drinking water samples, are as follows:

Site 1 : 0.0002 mg L⁻¹ (May & June 2011) –
BDL (Below Detectable Level)

Drinking water samples showed levels of cadmium within permissible BIS (0.01 mg L⁻¹) limits.

Arsenic (As): Long term exposure to Arsenic can give rise to health effects in large number of organs. Hyperkeratosis of palms and soles of feet, hyper pigmentation etc. Skin tumors on hands and feet have also been reported. Haemangioendothelioma of liver, a very rare form of cancer is also associated with long term Arsenic exposure. Other effects of Arsenic include peripheral vascular disturbances resulting in gangrene and a disease called as black foot disease [10]. The minimum and maximum value of heavy metals in the water samples collected from different areas of Delhi are as follows:

Site 2 : 0.0008 mg L⁻¹ (June 2011) –

Site 3 : 0.002 mg L⁻¹ (August 2011) to
 0.0007 mg L⁻¹ (June 2011) –
 0.01 mg L⁻¹ (August 2011)

Traces of Arsenic found in some water samples was within the range of 0.0008 mg L⁻¹ to 0.01 mg L⁻¹ which falls within the permissible limits

Mercury: Mercury intoxication is characterized by effect on Central Nervous System and the areas mainly affected are those associated with sensory, visual, auditory functions and those concerned with coordination. The developing nervous system of fetus is more sensitive to Mercury exposure than the adults. Prenatal exposure can result in neurotoxic effects in infants in the absence of effects in the mother [11].

APPLICATION

The studies are useful to educate the public about quality of drinking water which they are taking.

CONCLUSION

Drinking water samples collected from Delhi city did not have any heavy metal and pesticides contamination beyond BIS permissible limits. Hence, were found fit for drinking purpose.

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