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Persistent organochlorine pesticide residues in studied surface water lakes of Dharwad City, Karnataka, India

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Abstract
This research aims to evaluate the presence and distribution of pesticides in four lakes of Dharwad City, Karnataka. The residue level of pesticides were quantified in 4 samples during the year 2017, water samples from Nisargara lake, Sadanakere lake, Someshwara lake and Unkalkere lake region of Northern Karnataka. Samples were extracted for pesticide preparation prior to analysis with Gas Chromatography. A total of 17 organochlorine pesticides were examined. The experimental results revealed that, Heptachlor epoxide detected in the Nisargara lake and Someshwara lake but in Sadankere lake and Unkalkere lake pesticide residue not detected.

Keywords: organochlorine pesticide, surface water, lakes, residue

Introduction

The analysis of environmental pollutants and their metabolites in different compartments of the environment have been widely used to study the risk posed by this kind of contaminants to aquatic systems. Organochlorine pesticides have been of worldwide concern due to their chronic toxicity, persistence, tendency to accumulate in biota and potential negative impacts on humans and wildlife [10]. They are persistent, broad spectrum toxicants that accumulate in the food web with high risks to the ecosystem and human health [11, 9].

In order to protect natural populations of aquatic organisms, it is necessary to understand and predict the adverse effects arising from exposure to chemical contaminants. Chemicals enter aquatic systems via various pathways and in many cases the aquatic organisms are exposed to repeated pulses or fluctuating concentrations.

Among various organic and inorganic water pollutants, pesticides are very dangerous and harmful because of their tissue degradation and carcinogenic nature. Pesticides are bioaccumulative and relatively stable, as well as toxic and therefore, require close monitoring.

The BIS guideline values (2003) concerning the quality of water for human consumption established the maximum concentration of the total pesticides concentration at 1 mg/l. The majorities of the organochlorine pesticides are very persistent in environmental media and generate severe adverse health impacts. All these considerations motivated the need for the current study.

Materials and Methods

Sampling stations were selected, keeping in view, the important industrial waste discharge zones and nature of domestic activities and agricultural run-off. For the analysis of pesticide residues, water samples were collected in one liter amber colored bottles transferred to a separating funnel. Sodium sulphate (10g) was added to the separating funnel and shaken well. The water sodium sulphate mixture was extracted with dichloromethane (3x100 ml). After each separation, the upper organic layer was collected in a separate beaker and the lower aqueous layer was again extracted with 100 ml of dichloromethane. The combined dichloromethane layers were reduced in volume on a rotary evaporator to about 5ml. The crude extracts were cleaned up by florisil column chromatography. Glass columns were packed from the bottom with a glass wool plug, 8 cm of deactivated florisil and 4 cm anhydrous Na_2SO_4 to remove excess oil and fat and moisture content respectively. The packed column was pre-washed with 50 ml of petroleum ether. The extract was transferred to the column and eluted with 200 ml petroleum ether, mixed with diethyl ether (85:15). The combined extracts were evaporated almost to dryness and the final volume reached to 5 ml with GC grade solvent as described in (APHA,1995) standard methods and the water extracts were subjected to GC analysis. The extracts were transformed to the column eluted with 160 ml petroleum ether mixed with diethyl ether. The combined extracts were evaporated almost to dryness and the final volume of 5 ml was obtained with GC grade solvents. The identification and quantification of compounds were carried out using a Gas Chromatography (Chemito GC 1000), with Electron Capture Detector. GC column employed were capillary column, DB-1701 and DB-5. Pure analytical grade pesticide standards were used for GC analysis is reference standards. The temperature programs of GC were: injector 230^{o}C, column 220^{o}C and detector 260^{o}C. Ultra pure nitrogen gas was used as carrier gas. Winchrome 1000 chromatography data processor was used to record the chromatograms and peak areas were used to calculate the pesticide residues in the samples. These compounds were identified as individually resolved peaks based on retention times, in comparison with the corresponding peak height of the standards.

Results and Discussion

Table 2: Pesticide residue concentrations of water samples of Lakes

Name of the Pesticides	Unit	IN-12 Nirsagara Lake	IN-13 Sadanakere Lake	IN-14 Someshwara Lake	IN-15 Unkalkere Lake
Alpha-HCH	PPb	Absent	Absent	Absent	Absent
Gamma-HCH	PPb	Absent	Absent	Absent	Absent
Heptachlor	PPb	Absent	Absent	Absent	Absent
Aldrin	PPb	Absent	Absent	Absent	Absent
Beta-HCH	PPb	Absent	Absent	Absent	Absent
Delta-HCH	PPb	Absent	Absent	Absent	Absent
Heptachlor epoxide	PPb	40	Absent	71	Absent
Endosulphan-1	PPb	Absent	Absent	Absent	Absent
4,4-DDE	PPb	Absent	Absent	Absent	Absent
Dieldrin	PPb	Absent	Absent	Absent	Absent
Endrin	PPb	Absent	Absent	Absent	Absent
Endosulphan-11	PPb	Absent	Absent	Absent	Absent
4,4-DDD	PPb	Absent	Absent	Absent	Absent
4,4-DDT	PPb	Absent	Absent	Absent	Absent
Endrin Aldelyde	PPb	Absent	Absent	Absent	Absent
Endosulfan Sulfate	PPb	Absent	Absent	Absent	Absent
Methoxychlor	PPb	Absent	Absent	Absent	Absent

The total of 17 organochlorine pesticides were examined out of 4 samples of lakes, two were found to be contaminated with Heptachloro and Heptachloro epoxide. Detection of pesticide residues in the water samples of lakes summarized (Table 1) and residue levels of organochlorines were represented in (Figs). It shows that, organochlorine residues in the water samples is only Heptachloro epoxide (40 ppb) in the Nisagara lake and 71ppb Someshwara lake. Pesticide residues not detected in any of the water samples of Sadanakere lake and Unkalkere lake.

Heptachlor is applied as a soil treatment, as a seed treatment (maize, small grains and sorghum) or directly to foliage. It is used to control ants, cutworms, maggots, termites, thrips, weevils, wireworms and many other insect pets in both cultivated and uncultivated soils. Heptachlor also controls household insects and pests of humans and domestic animals [13]. In many countries, heptachlor is banned or applied only by subsurface injection. Heptachlor epoxide is not commercially available but is an oxidation product of heptachlor [12].

Heptachlor is moderately persistent in soil, where it is mainly transformed into its epoxide. It may undergo significant photolysis, oxidation and volatilization [14-16]. It binds to soil particles and migrates slowly [17]. The soil half-life of heptachlor under certain conditions may be as long as 2 years [18]. Heptachlor epoxide is very resistant to further chemical or biological changes in soil. It binds to soil particles and migrates slowly. Its half-life in various soils has been reported to be as long as several years.

Clinical case-studies of acute exposure (via the oral, dermal or inhalation route) to chlordane-containing heptachlor document a pattern of central nervous system effects similar to that found in animals (e.g., irritability, salivation, labored respiration, muscle tremors, convulsions) [20, 21]. Heptachlor does not appear to be carcinogenic in humans [22-25].

Conclusion

Based on the experimental results it can be concluded that, the important harmful effect of these pesticides occurs in aquatic systems. They can accumulate in water and then show their toxic effects. This effect causes the decrease of usable waters and has a bad effect on aquatic organisms directly. Because of these effects, water source should be monitored continuously [1]. In view of our observations suggest that further investigation on surface water for persistent organochlorine pesticides are needed to elucidate future pollution trends and to assess especially human and children health risk.

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