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ORGANOCHLORINE INSECTICIDE RESIDUES IN SEDIMENTS FROM THE COAST OF CHITTAGONG, BANGLADESH

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ABSTRACT: A total of 5 samples of marine sediments were analyzed for residues of organochlorine insecticide from the coast of Chittagong, Bangladesh. The analytical method consisted of 3 phases, extraction, clean-up and, analysis through Gas Chromatography (GC) with Electron Capture Detector (ECD). The concentration ranges were as follows 0.18 - 1.33 $ng.g^{-1}$ for aldrin, 0.2 - 1.84 $ng.g^{-1}$ for dielddrin, 0.30 - 1.31 $ng.g^{-1}$ for endrin, 0.11 - 0.26 $ng.g^{-1}$ for lindane, 0.56 - 3.36 $ng.g^{-1}$ for heptachlor, 0.2 - 1.51 $ng.g^{-1}$ for P,P' DDE, 0.18 - 2.91 $ng.g^{-1}$ for P,P' DDD, 0.11 - 3.12 $ng.g^{-1}$ for P,P' DDT. These results reveal that the sediments along coast of Chittagong are slightly contaminated with some of these organochlorine insecticides.

KEY WORDS: Organochlorine insecticides, sediments, coast of Chittagong, Bangladesh.

INTRODUCTION

Organochlorine insecticides are of environmental interest because of their proven toxicity to human beings, animals and plants. Although developed countries have already banned or heavily restricted the use of these insecticides, most of these compounds are still in use in underdeveloped countries (Anon, 1989). In Bangladesh, about 6,537 metric tons of formulated insecticides and acaricides are used annually for agricultural purposes (APB, 1992). Organochlorine pesticides comprise nearly 7.6% of the total insecticides in use (Rahman *et al.*, 1995).

Many researchers have emphasized the importance of coastal environments as a reservoir of persistent organochlorines (Goldberg *et al.*, 1978). Jalees and Vemuri (1980) estimated that at least 5% of the insecticides used for agricultural and vector control purposes are expected to reach the coastal waters. Based on this assumption, it is expected that the amount of insecticide and acaricide load along the coast of Bangladesh may be about 326.85 metric tons.

No monitoring system for pesticides used in various sectors has been developed yet in Bangladesh. As such, no data concerning the residue level of organochlorine insecticides in marine sediments from the coast of Bangladesh are available. Hence, the main purpose of the present study was to determine the residue level of organochlorine insecticides in the sediments of the Karnafully River mouth upto Kutubdia channel of the Bay of Bengal.

MATERIALS AND METHODS

Area of study:

Karnafully, the most important river of Chittagong District, originates from the lofty

ranges of Lusai Hills of Assam in India and enters the district of Chittagong from the north-eastern side. The total length of the Karnafully River is about 170 miles. The study area represents a great interest, because the rivers Karnafully and Sangu during their course to the Bay of Bengal receives agricultural wastes and untreated effluents of pesticide manufacturing plants.

Samples:

Surface sediment samples were collected from the 5 stations (Fig. 1) during a cruise with a Landing Craft Tank (LCT) of the Bangladesh Navy (March, 1994) using an Ekman grab sampler. Samples were sealed in precleaned glass jars and transferred to the Institute of Food and Radiation Biology (IFRB), Atomic Energy Research Establishment (AERE), Dhaka for extracting and subsequent analysis.

Chemicals and Reagents:

Chemicals and reagents used were diethylethr, hexane and acetone all of pesticides grade. Prior to use, hexane was double distilled by a Glass apparatus at 69°C. Anhydrous sodium sulfate and Florisil (mesh 60-100/PR) were used in this investigation.

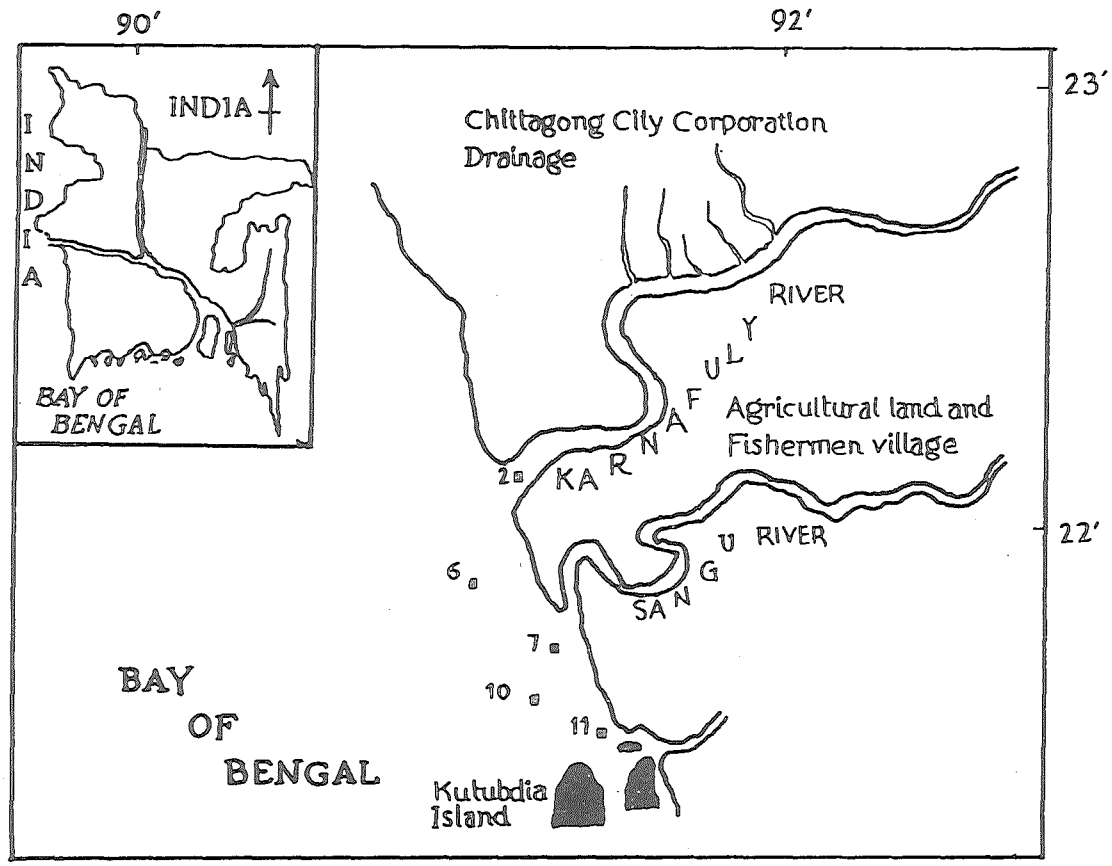

Fig. 1. Location of the study area and sampling stations.

Extraction and Cleanup:

Samples were prepared for Organochlorine insecticides analysis according to previously described methods (Caricchia *et al.*, 1993). The extracts were concentrated in a rotary vacuum evaporator (Type 390) and transferred quantitatively in a conical flask.

Florisil 60-100 mesh was activated by heating in a oven at 130°C for 6 hrs and cooled in a dessicato. The freshly activated florisil was then partly deactivated by drop wise addition of distilled water (3%V/W, water/ florisil) at 40°C with constant stirring for 1 hr. The column was eluted with 150 ml of 2% diethylether in hexane at a flow rate of 1-2 drops per second (5 ml min^{-1}).

Operating conditioning of GC:

The Gas Chromatograph (UP - 4500) was equipped with an ECD and a Pyrex glass column of 1.5 m long, 2 mm i-d, packed with 1.5% or-17 +1.95% OF on 100-120 mesh chromosorb were used for organochlorine insecticides. A data handling computing integrator (PU-4815) was used for data graphics and reports.

Analytical condition of GC:

Nitrogen gas was used as a carrier gas at a flow rate of 25 ml min^{-1}. Temperature during ECD mode was 224°C at the detector, 211°C at the injector, 201°C at the column. The running time for the whole chromatogram was 35 min. The injection volume of the extract was 0.5 µl and the attenuation of the integrator was 32.

Identification and quantification:

Identification and quantification was done from based on the retention time in the GC with respect to a standard solution of organochlorine insecticides which were prepared from individual pure compounds, purchased from Chromopack, Middleburge, UK. The concentration of each compounds were calculated from the peak area with respect to the standard peak area.

RESULTS AND DISCUSSION

Organochlorine insecticides namely Aldrin, Dieldrin, Endrin, Lindane, Heptachlor, DDt and its metabolites were determined from the five station located in the Chittagong coast. Table-1 represents the residue data of organochlorine insecticides in sediment samples. Standard chromatogram versus chromatogram of sediment samples are presented in figure 2. DDT was significantly higher then other organochlorine insecticides at all the stations and the concentration were in the order of ∑DDT> Heptachlor> Dieldrin> Endrin> Aldrin> Lindane. Among the metabolities of DDT, the concentration of P,P' DDT was the most abundant. P,P' DDE is a degradation product of P,P' DDT, that can be formed either by natural UV - irradiation or by metabolism of organisms (Sanchez *et al.*, 1992). In the present investigation, the concentration of DDT metabolities ranged from 0.49 to 7.14 $ng.g^{-1}$. Similar findings were reported in the sediments of the San francisco Bay by the National Status and Trends program of NOAA (1987) and by Pereira *et al.*, (1994). In the Mediterranean coast, the values of DDT ranges between 0.4 and 200 $ng.g^{-1}$ (UNEP, FAO, WHO, IAEA, 1989) which is higher

Table 1. Organochlorine insecticide residues in marine sediments from the 5 stations located in the Chittagong coast, Bangladesh (values in ng.g^{-1})

Compounds	Sampling stations				
	ST. 2	St. 6	St. 7	ST. 10	St. 11
Aldrin	1.33	0.57	0.94	ND	0.18
Dieldrin	1.84	1.16	1.54	0.92	0.20
Endrin	0.95	0.94	1.31	0.30	ND
Lindane	0.21	0.26	0.16	0.11	ND
Heptachlor	3.36	0.56	ND	ND	ND
P,P' DDE	1.51	0.83	1.11	0.54	0.20
P,P' DDD	1.09	0.94	2.91	0.69	0.18
P,P' DDT	2.98	1.54	3.12	1.05	0.11
∑DDT	5.58	3.31	7.14	2.28	0.49

ND = Not Detected

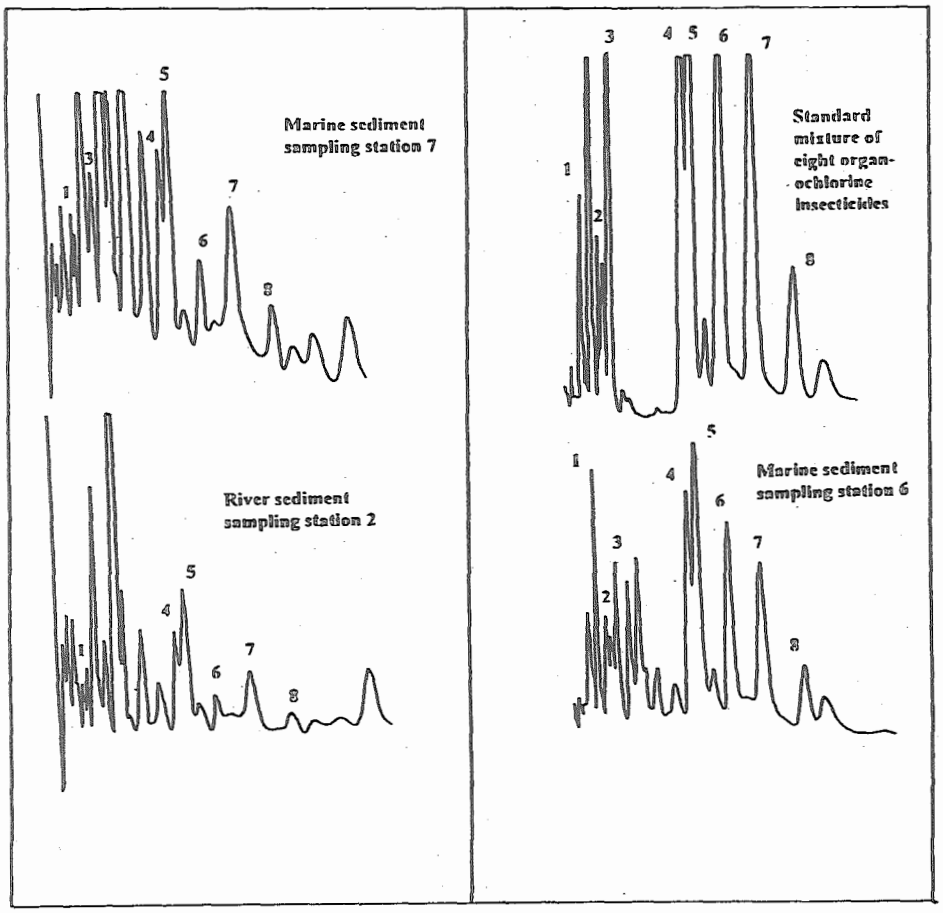

Fig. 2. Cromatograms of organochlorine insecticides (standard mixture of eight organochlorine insecticides, 1-Lindane, 2-Heptachlor, 3-Aldrin, 4-P,P DDE, 5-Dieldrin, 6-Endrin, 7-P,P DDD, 8-P,P DDT) and sediment samples at stations 2, 6, 7 (comparison).

than the values recorded in the present study. Table-2 represents a comparison of the concentration of organochlorine insecticides in sediments found in this study and the published values within marine sediments from various locations.

Table 2. Comparison of detected values of organochlorine insecticides in different locality (values in ng.g^{-1}).

Locality	P,P' DDE	P,P' DDD	P,P' DDT	ΣDDT	Dieldrin	Aldrin	Endrin	Lindane	Heptachlor
Indian Ocean (1992)				7.4-179.1	0.5	0.01-0.5		0.01-0.21	
Coast of Alicante, Spain, (1992)	0.23	0.7	0.05	0.35		0.001			0.001
San francisco Bay Delta estuary, (1994)	3.9	1.9	3.2	9.0					
Manukau harbour, New Zealand, (1988)	0.5	0.3	0.1	0.9	0.5	0.53	0.1		0.1
Chittagong coast, Bangladesh, (Present study)	0.2-1.51	0.18-2.91	0.11-3.12	0.49-7.14	0.2-1.84	0.18-1.33	0.30-1.31	0.11-0.26	0.56-3.36

The sources that contribute organochlorine insecticides to the sediments are presumably contaminated runoff form agricultural areas in the upper reaches of the river or atmospheric deposition. The same view has been expressed by Pereira *et al.*, (1994) and Sarker and Sengupta (1991). Variations in the residue levels of different organochlorine pesticides along the coastal region can be attributed to variations in physico-chemical properties of coastal waters and biogenic matter influencing the degradation of the pesticides (Sarkar and Sen Gupta, 1986; Sarkar and Banerjee, 1987).

The usages of chlorinated pesticides in crop production and in public health practices are banned or restricted in developed nations (Rajendran *et al.*, 1992) but are still in use in Bangladesh (Rahman *et al.*, 1995). A report of Showler (1989) states that old organochlorine stocks including Toxaphene and Heptachlor are still being employed for agricultural purposes in Bangladesh. A DDT manufacturing plant near Barabkunda, Chittagong is still producing 1000 tons of DDT daily (IUCN, 1991). The effluents of this plant are dumped into aquatic and this also represents a point source of DDT within the coastal environment.

The annual consumption of insecticides comprise 96.67% fungicides, 1.47% wedicides and others 0.7% of which include acaricides, rodenticides etc. (Rahman *et al.*, 1995). A large quantity of these organochlorine insecticides have been added to dry fish for preservation from insect attack since early 1980 indicating their popular use.

The residue levels of organochlorines in sediments may become significant in future, because of the continuing use of these persistent chemicals in agriculture, public health and industry. So a restriction must be imposed on the uses of organochlorine insecticides to prevent future adverse impact on coastal environment. Further monitoring of organochlorine insecticides residues in sediment samples would give a better picture of the level of contamination.

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