

Organochlorine Pesticide Contamination of Rain-water, Domestic Tap-water and Well-water of Karachi City

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Summary: The presence of six organochlorine pesticides has been studied in rain-water, tap-water and underground-water of Karachi. The probable sources of these insecticides in the atmosphere and water are discussed.

Introduction

Karachi has three main water resources, the domestic tap-water supply, the well-water and the rain-water. The tap-water supplied to Karachi is the river Indus water, channeled through Guggu canal and water filtration plant at Bhambore. Hence all contaminants of Indus river across the country reach Karachi. Inland water of Karachi also originates from the canals and tributaries of Indus river. The cultivation in most parts of Pakistan is dependent on canal water or rain water. The crops are extensively sprayed with pesticides including organochlorine compounds. These pesticides which are volatile, persistent and toxic [1-5], find their way into rivers and canals and ultimately into drinking water supply of Karachi.

The water and air of Karachi are thus expected to be contaminated with such insecticides or their degradation products which are likely to be present in tap-water, well-water and rain-water [6-18].

We made a systematic study of the presence of six organochlorine pesticides such as DDT, BHC, Endrin, Endosulphan, Dieldrin and Heptachlor in rain-water, tap-water and well-water at several places of Karachi.

The sites chosen for collection of samples ranged from residential localities such as Defence Housing Authority, PECHS, Gulshan-e-Iqbal, North Nazimabad, Nazimabad, F. B. Area, Shah Faisal Colony and also from Saddar which is the city centre. Landhi and Orangi which are industrial cum residential areas were also included in the study. Most of the residential areas are thickly populated and have flourishing business centres. There are pockets of small industries scattered in the various areas.

Results and Discussion

Rain-water

Only BHC and DDT were detected (Table 1). All the other organochlorine pesticides were not detected. Even BHC and DDT were found to be absent in our previous study of rain water [21]. This is an indication of the enhanced use of these insecticides in the country.

Two mechanisms could be offered for the presence of these insecticides in the atmosphere and clouds of Karachi. The pesticides are transported through wind from the Punjab and northern parts of Pakistan which are heavily cultivated throughout the year. The other possibility is the long range transportation of these insecticides by the Monsoons which originate in the Arabian sea, pass over and bring rain in various parts of India. Finally they cross Rajasthan, Run-of-Kutch and bring rain at Karachi. The first route is unlikely because it is known that monsoons which travel through Rajasthan bring rain to Karachi. Such long range transportation [22-34] of pesticides from their emission sources have also been observed in the rain-water of certain European countries and Japan where they are accumulated by the presence of smoke and high particulate contents in the atmosphere [35-42].

Domestic Tap-water

BHC was present in all the sample examined by us (Table 2) and its concentration was remarkably higher in the samples of Defence Housing Authority, Orangi and Hyderabad as compared to that of Guggu canal. This suggests enhanced use of this pesticide in the two twin cities, perhaps for the killing of garden and domestic pests. Similarly Endrin was present in the waters of Guggu canal.

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Table 1: Rain-water (ng/l)

	BHC	DDT	Dieldrin	Endosulphan	Endrin	Heptachlor
Gulshan-e-Iqbal Karachi University North Nazimabad Saddar	-	1940	-	-	-	-
	2840	-	-	-	-	-
	-	760				
	640	1380				

Table 2: Domestic Tap-water (ng/l)

	BHC	DDT	Dieldrin	Endosulphan	Endrin	Heptachlor
Guggu canal	520	-	540	-	60	-
Defence	4480	-	-	-	2960	3000
Gulberg	220	-	480	-	160	-
Landhi	340	-	380	-	600	-
Nazimabad North	1780	-	-	-	140	-
Nazimabad	440	200	-	16.8	300	260
Organgi	5180	4360	-	-	160	100
PECHS	700	-	-	-	320	-
Saddar	760	2200	-	-	1160	140
Hyderabad	1020	13160	440	260	-	4180

This is one of the pesticide used extensively in farms and fields as well as in gardens in Karachi. Its presence in Guggu canal water should originate from Indus river where it is presumably washed down from the farms and fields by rain.

Endosulphan and Heptachlor are absent in Guggu canal but are present in Hyderabad and at a few sites in Karachi where it is largely used for killing of termites and domestic pests.

It is quite interesting to speculate how the pesticides are transmitted into drinking water lines. It appears as if the drinking-water line system is defective and at places it is mixed up with the sewage lines resulting in the mixing of drinking-water with the unclean-water.

The distribution of Dieldrin is homogeneous in the various samples examined by us pointing out its common source, the waters of river Indus.

The concentrations of BHC and Heptachlor is remarkably high in Defence Housing Authority which is a posh residential area. The two pesticides are to be widely used for killing pests such as termites in the area.

Underground-water

The underground-water seems to have BHC invariably present in the samples of all these areas and it is also present in the drinking-water of all regions of Karachi (Table 3) included in this study as well as Guggu canal. Such frequent occurrence of BHC in the drinking- as well as underground-water indicates that this pesticide should be present in Indus river water and likely have enhanced through seepage and rain. This pesticide is used on crops in the fields up country and could find its way into the river water during rain seasons.

Table 3: Underground-water (ng/l)

	BHC	DDT	Dieldrin	Endosulphan	Endrin	Heptachlor
Federal B Area	1600	-	-	-	-	-
North Nazimabad	700					
Shah Faisal Colony	3040	740	-	-	-	500

The underground-water of Shah Faisal Colony contains Heptachlor in addition to BHC. The same pesticide was found in the drinking-waters in four areas of Karachi and also in Hyderabad. Since this pesticide is extensively used in these areas it might have found way through underground-water into wells of Shah Faisal Colony. However, the reason for its presence in well-water of Shah Faisal Colony remains uncertain.

Experimental

The rain water was collected in triplicate at four different stations in July 1988 when it had rained after a gap of one year. The tap water was sampled at ten and the well water was collected at three different sites of Karachi. Three samples were collected and analysed from each site. Tap water was also collected from Hyderabad city which is situated about 160 km north of Karachi. The water of Guggu canal was sampled near Bhambore (over 70 km from Karachi) from where the water is supplied to Karachi water treatment plant and distributed to various localities of Karachi after purification. All the samples were collected in glass bottles and were frozen till sample preparation.

The samples were analysed gas chromatographically using internal standard method after extraction and clean up [19,20]. For this purpose the pesticide residues were extracted with 15% hexane-ether, concentrated and were cleaned up on florisil columns. The purity of the solvents used were checked by GLC. A GLC model Pye Unicam 204 equipped with electron capture detector (^{63}Ni) was used. Glass column (1 m x 0.4 m) charged with 1.5% SP-2250, 1.95% SP-2401 on 100/120 supelcoport were used. Nitrogen with a flow rate of 30 ml/minute was used as a carrier gas. The column, injector and detector were operated isothermally at 180, 200 and 250°C respectively.

Conclusion

This study indicates that the pesticides used in the field hundreds of miles away can find their way into the areas through river water and get into the remote areas by river water into the inland and drinking-water. The extensive use of pesticides can pollute atmosphere appreciably and all of these hazardous chemicals ultimately find their way into animals and human body. They can create health hazards and can also damage ecological balance. Our study is indicative of the environment of the city and contamination of rain-water, domestic tap-water and well- water with pesticide residues. The pesticides concentrations are found to be alarmingly higher than the desirable and permissible criteria of USA domestic water supply [43-45].

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