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Monitoring of Pesticide Residues in Different Sources of Drinking Water of Jaipur, India

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No living organism can survive without water. If such an integral and essential constituent of living organism is contaminated with pesticide residues it can be hazardous, slowly but surely. Various uses of pesticides by agriculturists and public health departments are the main sources of their residues reaching the surface and ground waters, including lakes, canals and wells. In the case of flowing waters the pesticide residues may travel long distances to cause contamination up to distal ends. Likewise, slow rainfall and sprinkler irrigation of fields result in the movement of pesticides downward in the ground, polluting thus the ground water. Occasionally, either accidentally or purposely, the pesticides are introduced in watercourses. Therefore, it was considered essential to study the level of contamination of different sources of water, tube well, open well and lake with pesticide residues. The objective of this study was to determine periodical changes in contamination of in tube well, open well and lake water around Jaipur (India) during 1997, 1999, 2000. Earlier the presence of different pesticide residues in various waterbodies were reported by Dikshith et al. (1990) and Jani et al. (1991).

MATERIALS AND METHODS

About 258 samples of water from three sources, namely, open well, tube well and lake were collected during 1997, 1999 and 2000 from villages nearby Jaipur. The range of depth of tube well was 50-120 m and that of the open well 10-80 m. The lake was spread over about 1 ha area. The water samples collected were analyzed for pesticide residues. For the analysis of water, 200 ml of water samples were taken in separatory funnel and 5 to 6 g of Sodium Chloride was added and shaken the funnel till Sodium Chloride was dissolved. Then 50 ml of 15% methylene chloride in hexane was added to the separatory

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funnel and the mixture was thoroughly shaken for 5 minutes, and allowed to remain undisturbed till two clear layers were formed. The solvent layer was separated and the aqueous layer was again partitioned twice with 50 mL portions of 15% methlene chloride in hexane and three times with 50 mL portions of ethyl acetate. All the solvent layers were combined and passed through anhydrous Sodium sulphate and concentrated in rotary vacuum evaporator to 0.5 mL. Then 5 mL of hexane was added to it and again it was concentrated to 0.5 ml. The process was repeated twice to ensure the complete removal of methylene chloride. The residue was then dissolved in 1-2 mL of acetone and the volume was made to 5 mL with hexane and analyzed for different pesticides. The analysis was done in GLC chemito 1000 model equipped with electron capture and nitrogen phosphorus detectors.

The organochlorine pesticides were analyzed with an electron capture detector using 1.5% OV-17 + 1.95% OV-210. The organophosphorus compounds were detected in NPD using the same column. The temperature parameters were oven, 210^0C, injection port, 230^0, detector 300^0C for organochlorine pesticides. For pyrethroids the temperatures of oven and injection port were kept at 270^0C. For organophosphate pesticides the temperatures were oven, 210^0C injection port 230^0C and detector 250^0C. For more polar organophosphate pesticides like monocrotophos, dimethoate, phorate phosphamidon, 0-demetonmethyl etc. 3% DEGS column was used. The temperature of the oven in this case was kept at 190^0C to avoid the column bleed. In all the cases the flow rate of the carrier gas (nitrogen) was kept at 60 ml/min. The reliability and efficiency of extraction and clean up procedures were checked by carrying out recovery experiments following the same procedure as employed in the experiment described above. The recoveries ranged from 98-100% for organochlorine pesticides, 95-100% for organophosphate pesticides and 94-98% for pyrethroids. The limit of detections of organo-chlorine pesticides were 0.1-1 ppb, of organophosphate pesticides 0.5-1 ppb, and of pyrethroids 1-5 ppb.

RESULTS AND DISCUSSION

The analytical data pertaining to pesticide residues detected in open well, tube well and lake waters during the three years are given in Table-1. In 1997 water samples from all the three sources showed

Table 1. Pesticide residues detected in water samples from three kinds of waterbodies during 1997, 1999 and 2000

Water body	1997				1999				2000			
	Samples analysed	Samples contaminated	Pesticide identified	Residues (ppb) Range	Samples analysed	Samples contaminated	Pesticide identified	Residues (ppb) Range	Samples analysed	Samples contaminated	Pesticide identified	Residues (ppb) (Range)
Tube well	46	38	HCH	0.45-330	18	18	HCH Endosulfan - sulfate α endosulfan O,PDDE PPDDD Dicofol Chlorpyriphos	0.34-21.54 0.01-25 0.29-1.19 0.96-4.0 1.50-1.90 1.39-3.0 2.42-3.73	34	30	HCH Dicofol Dieldrin α endo-sulfan Chlorpyri-phos	0.52-12.23 0.01-2.05 0.30-1.25 0.47-3.01 0.96-1.76
Open well	28	28	HCH	1.0-250	20	20	HCH Endosulfan-sulphate O,PDDE Dicofol Chlorpyriphos	2.2-58.49 23.20-39.25 0.8-29.55 2.30-4.53 2.09-6.87	40	38	HCH Dieldrin Endosul-fan sulfate Chlorpyri-phos	0.3-37.17 0.2-3.32 5.97-13.54 0.42-1.36
Lake	24		Nil	BDL	24	24	γ HCH O,PDDE	1.13-9.57 1.99-6.10	24	24	γ HCH α endo-sulfan Chlorpyri-phos	0.55-6.04 0.01-15.0 0.44-1.10

HCH residues. Out of 46 tube well water samples, 38 (82.6%) were found contaminated with HCH residues in the range of 0.45 - 330 ppb. All the 28 (100%) water samples of open well analyzed were contaminated with HCH residues in the range of 1.0 - 250 ppb. But in the 24 water samples collected from Ramgarh Lake of Jaipur, the pesticide residues were below detectable limit. This may be due to the dilution of pesticide residues in water of the vast lake.

The perusal of the data in Table-1 further showed that the water samples collected during 1999 showed pesticide residues of different nature. All the 18 samples of tube well water showed contamination with residues of one or more insecticide viz. HCH, DDT, endosulfan sulphate and chlorpoyriphos. The endosulfan sulfate residues were present in highest concentration (25 ppb) in two samples, followed by HCH (21.54 ppb). In case of open well, all the 20 samples analyzed showed contamination with insecticides like HCH, endosulfan, DDT, dicofol and chlorpyriphos residues. The ranges of concentration of chlorpyriphos, HCH, DDT and endosulfan residues were higher than those detected in the tube well water.

The samples from lake water showed HCH and DDT residues in 1999 but the concentrations of the residues were lesser than those detected in the tube well and open well waters. This looked again due to the large volume of water in the lake causing dilution of the pesticides. The samples analyzed during the year 2000 showed decrease in the amount of residues of different insecticides in all the three sources of water. DDT residues were totally absent but dieldrin residues appeared in the samples of tube well and open well water. Chloropyriphos and endosulfan residues were detected in the lake water during 2000. No α endosulfan residues appeared in open well water during 1999 and 2000.

It was concluded from the studies reported here that the kind of pesticide residues and their concentrations present varied among the three kinds of waterbodies, as well as with time, from year to year. In any case, safeguards were needed for the judicial use of pesticides by agriculturists and Public Health Departments alike to minimize their residues reaching various waterbodies.

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