United States
Environmental Protection
Agency

Health Effects Research
Laboratory
Research Triangle Park NC 27711

Research and Development

EPA-600/S1-81-024 Apr 1981

EPA

Project Summary

Method Development for the Assessment of Possible Human Exposure to Pesticides and Industrial Chemicals

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The determination of chlorinated phenols in urine can be used as a means for assessing exposure to pesticides and industrial chemicals in the human population.

A method was developed for the analysis of chlorinated phenols which involves the derivatization of metabolites from the urine of rats fed hexachlorobenzene (HCB) and pentachlorophenol (PCP). This method was then applied to urine samples taken from the general human population to gain a background level. Pentachlorophenol was detected in greater than 90% of the human samples analyzed. The only other metabolites detected were tetrachloropyrocatechol and tetrachlorohydroquinone. The urine of a worker occupationally exposed to PCP exhibited quantifiable amounts of tetrachloropyrocatechol and tetrachlorohydroquinone along with large amounts (greater than 3 ppm) of PCP. Pentachlorothiophenol, a major metabolite of HCB fed to rats, was not detected in human urine.

The analysis of human urine for underivatized chlorinated phenols using a direct gas chromatographic method not requiring derivatization detected quantifiable levels of 2,5-dichloro-, 2,4,5-trichloro-, 2,3,4,6-tetrachloro- and pentachlorophenol in greater than 90% of the samples examined. Approximately 50% of the samples contained detectable levels of 2,6- and 3,5-dichlorophenol and 2,4,6-trichlorophenol.

Introduction

Chlorinated phenols have been of concern to the environmental scientist for many years. Their toxicity to fish and other aquatic life is well documented in the literature The presence of chlorophenols in industrial effluents has been widely demonstrated. Methodology was developed to analyze for chlorinated phenols in urine to assess possible human exposure to chemicals known or suspected to give these compounds as metabolites.

The most widely used and studied chlorinated phenol is pentachlorophenol (PCP). It has been used extensively in the wood products industry as a preservative and in agriculture as a fungicide. A discussion of its uses, toxicity, and fate in the environment can be found in the literature. The occurrence of PCP in humans from occupationally exposed workers and the general human population is also well documented.

Table 1. *Possible Origins of Various Chlorinated Phenols*

Metabolite	*Origin*	*Type Pesticide*
2,6-dichlorophenol	*Lindane*	*Insecticide*
2,4-dichlorophenol	*Lindane*	*Insecticide*
	VC-13	*Insecticide*
	m-dichlorobenzene	*Fumigant*
	2,4-D	*Herbicide*
2,3-dichlorophenol	*Lindane*	*Insecticide*
	o-dichlorobenzene	*Fumigant*
2,5-dichlorophenol	*Lindane*	*Insecticide*
	2,4,5-T	*Herbicide*
	p-dichlorobenzene	
3,4-dichlorophenol	*Lindane*	*Insecticide*
	o-dichlorobenzene	*Fumigant*
	Diuron	*Herbicide*
3,5-dichlorophenol	*Lindane*	*Insecticide*
	PCP	
2,3,4-trichlorophenol	*Lindane*	*Insecticide*
2,3,5-trichlorophenol	*Lindane*	*Insecticide*
	PCP	
2,3,6-trichlorophenol	*Lindane*	*Insecticide*
2,4,5-trichlorophenol	*Lindane*	*Insecticide*
	Ronnel	*Insecticide*
	Erbon	*Herbicide*
	2,4,5-T	*Herbicide*
	HCB	*Fungicide*
	Tetrachlorvinphos	
2,4,6-trichlorophenol	*Lindane*	*Insecticide*
3,4,5-trichlorophenol	*Lindane*	*Insecticide*
2,3,5,6-tetrachlorophenol	*HCB*	*Fungicide*
2,3,4,6-tetrachlorophenol	*PCP (impurity)*	*Fungicide*
	Lindane	*Insecticide*
2,3,4,5-tetrachlorophenol	*PCP*	*Fungicide*
	Lindane	*Insecticide*
	HCB	*Fungicide*
pentachlorophenol	*PCP*	*Fungicide*
	Lindane	*Insecticide*
	HCB	*Fungicide*
	PCNB	*Fungicide*

The metabolism of PCP and other chemicals which give rise to PCP and other chlorinated phenols as metabolites can be found in the literature. A listing of possible sources of chlorinated phenols is found in Table 1. The list is by no means complete, but does give some insight nto possible origins of various chlorinated phenols that might be encountered in exposure assessment work.

Metabolism studies and analytical methods development were conducted using rats fed two chemicals, pentachlorophenol (PCP) and hexachlorobenzene (HCB), which were known or suspected to metabolize to chlorinated phenols The method was then applied to urine samples from the general human population and the urine of a worker occupationally exposed to pentachlorophenol.

The literature contains no apparent methodology for the determination of lower chlorinated phenols in urine at the low ng/g level. Because of this, a method was developed in an attempt to detect mono-, di-, and trichlorophenols in urine. No metabolism studies were performed, but the method was applied to general human population urine samples.

Conclusions

Pentachlorophenol, 2,5-dichlorophenol, 2,4,5-trichlorophenol and 2,3,4,6-tetrachlorophenol were found in greater than 90% of the human urine samples analyzed. Since all but one of the samples was from the general population, it is difficult to determine a common exposure route. The urine of workers occupationally exposed to other chemicals which can give chlorinated phenol metabolites and further animal feeding studies need to be conducted before definitive exposure assessments can be made.

The determination of chlorinated phenols in urine can possibly be used as an index of exposure to numerous chemicals.

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The complete report, entitled "Method Development for the Assessment of Possible Human Exposure to Pesticides and Industrial Chemicals," (Order No. PB 81-175 796; Cost: $6.50, subject to change) will be available only from:

National Technical Information Service
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