

Seasonal Concentrations of PCBs and Organochlorine Pesticides (OCs) in the Ambient Air in the City of Gdańsk, Poland

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Abstract

Polychlorinated biphenyls (PCBs), hexachlorocyclohexanes (α , and γ -HCH; HCHs), hexachlorobenzene (HCBz), DDT and its analogues (*p,p'* - DDT, *o,p'* - DDT, *p,p'* - DDD, *p,p'* - DDE; DDTs) and chlordanes (*trans*-chlordanane, *cis*-chlordanane and *trans*-nonachlor; CHLs) were quantified in the ambient air in city of Gdańsk during September 1991-July 1992. PCBs, HCHs, HCBz, DDTs and CHLs concentrations in air averaged 360 ± 280 , 370 ± 620 , 140 ± 80 , 240 ± 400 and < 30 pg/m^3 , while median concentrations were 270, 180, 120, 78 and < 30 pg/m^3 , respectively. A relatively high concentration of γ -HCH in ambient air sampled on September 1991 (2200 pg/m^3) and a high γ -HCH/ α -HCH ratio (17:1) indicate on a recent use of Lindane in an area somewhere south and south-west of Gdańsk. The concentrations of PCBs and HCBz correlated positively with the ambient air temperature ($p < 0.05$) and there was no such relationships for any other compound quantified.

Key words: Polychlorinated biphenyls, PCBs, Organochlorine pesticides, HCBz, HCHs, Lindane, DDTs, Chlordanes, CHLs, atmosphere, ambient air.

Introduction

The atmosphere is considered as an efficient pathway of transportation and dispersion of semivolatile organohalogenated pollutants in the environment at the global scale. The thermodynamics of the global transportation and diffusion process of highly lipophilic and semivolatile organohalogenated compounds is under impact by climatic differences in various regions of the world and including a seasonal differences and fluctuations in the

soil, surface water and lower troposphere temperature, the rates of moisture volatilisation and deposition (fog, rain, snow) as well as a direction of the air masses movement (1, 2).

Materials and Methods

11 air samples were collected from the city of Gdańsk in the period from September 1991 to July 1992. A sampling device for air was located ~14 m above the ground level at the campus of the Faculty of Pharmacy of the Medical University of Gdańsk. A precleaned polyurethane foam plugs (length 50 mm, diameter 31 mm and density $20 \pm 2 \text{ kg/m}^3$) packed in a glass column (length 390 mm, i.d. 27 mm) were used as adsorbent of organochlorine compounds. The sampling columns were prepared in laboratory under controlled condition and kept clean (topped with polyethylene caps at both ends and sealed in polyethylene bags) until used (2, 3). On a 48 h basis ~88 m³ of air were aspirated using the prepared glass column connected with a low volume air pump.

OCs and PCBs adsorbed on polyurethane foam were extracted using 400 ml of the mixture of acetone and *n*-hexane (3:1; v/v) for 3 h in a Soxhlet apparatus. After microconcentration of the extract down to 100 μl by using a Kuderna-Danish concentrator and a stream of nitrogen, 5 ml of acetone was added and the *n*-hexane was removed. The acetone extract was then transferred to 10 ml of *n*-hexane in a separatory funnel (2, 3). Next the *n*-hexane extract was cleaned-up with 5 % fuming sulphuric acid in concentrated sulphuric acid, washed with *n*-hexane-washed water, microconcentrated under a gentle stream of purified nitrogen gas down to 100 μl , and then further HPLC cleaned-up and fractionated prior to capillary GC/ECD quantification. The details of chemical analysis were the same as reported previously (2, 3).

Results and Discussion

PCBs and HCHs were the most dominant compounds in the Gdańsk air samples and followed by HCBz, DDTs and CHLs (Table 1). The seasonal fluctuations of OCs and PCBs in the period of sampling are shown in Figure 1. There is no earlier records available on OCs or PCBs in the ambient air in Poland for comparison purpose.

There was a peak of γ -HCH in September 1991 and also apparently higher concentrations of HCBz and PCBs, and for DDTs a peak was in September and November 1991 (Fig. 1). Interestingly, a relatively high concentration and a peak of HCHs runoff by the Vistula River water to the Gulf of Gdańsk, like in the case of the ambient air samples, were observed for August-September 1991 (4).

Both a relatively high concentration of HCHs (>90% of γ -HCH) in air sampled in September 1991 and a high γ -HCH/ α -HCH ratio (17:1) indicate on recent use of γ -HCH somewhere south or south-west of Gdańsk. Lindane was imported to Poland in 1956-1975, while produced domestically in 1964-1982 (5). Nevertheless, there is possibility, that an individual farmer could kept and use some deposits of Lindane up to 1991.

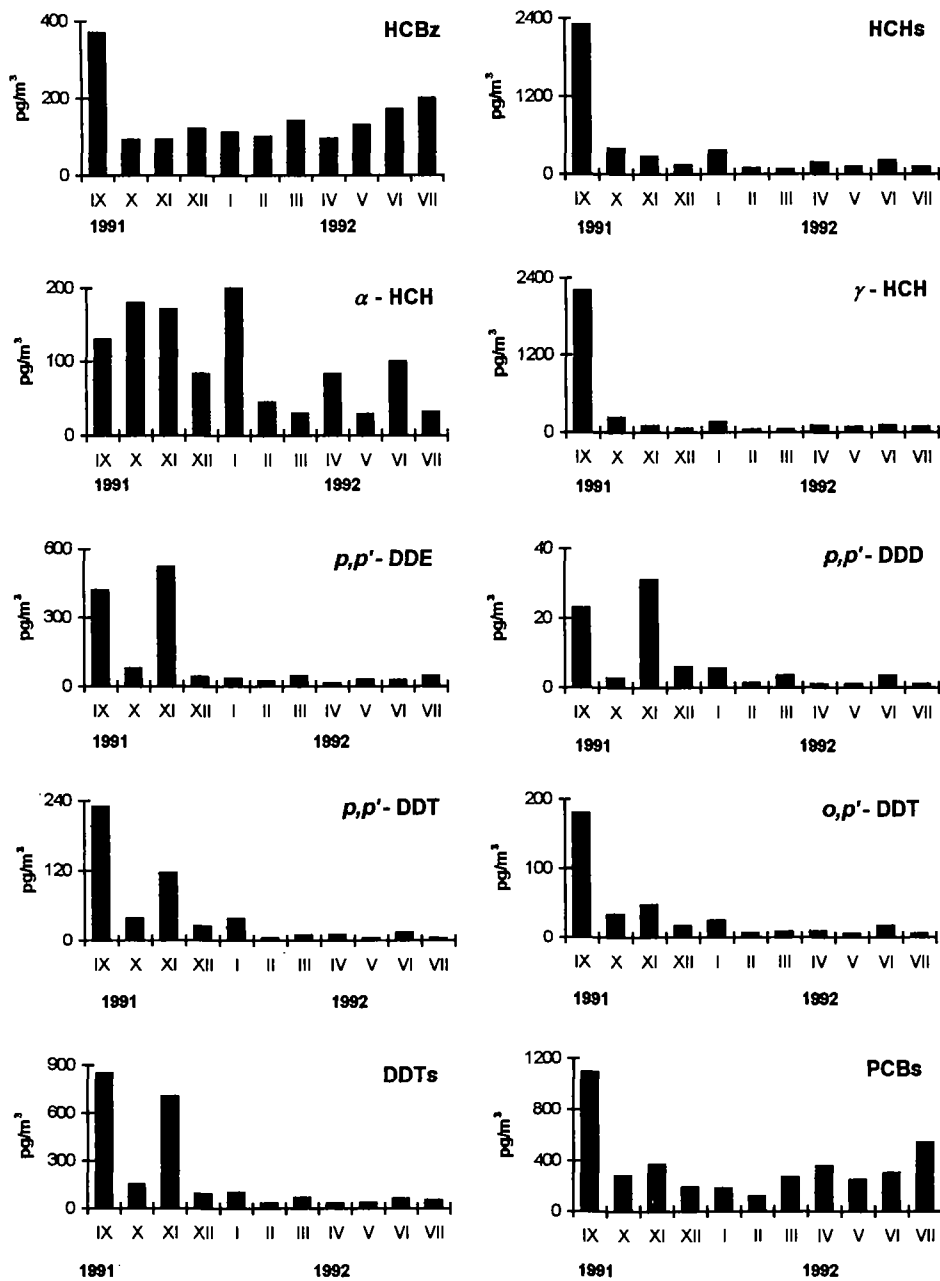


Figure 1. Concentration profiles of PCBs and organochlorine pesticides in ambient air in Gdańsk in 1991-1992.

Table 1. Polychlorinated biphenyls and organochlorine pesticides in the ambient air in city of Gdańsk (pg/m³)

Compound	Median	Mean±S.D	Range
HCBz	120	140±80	63-370
α-HCH	87	100±72	29-250
γ-HCH	97	270±610	42-2200
HCHs	180	370±620	75-2400
<i>p,p'</i> - DDT	20	51±78	4.6-230
<i>o,p'</i> - DDT	15	34±51	6-180
<i>p,p'</i> - DDE	42	150±290	13-1000
<i>p,p'</i> - DDD	3.5	9±13	1-45
DDTs	78	240±400	31-1300
<i>Trans</i> -chlordan		<14	
<i>Cis</i> -chlordan		<8.1	
<i>Trans</i> -nonachlor		<7.4	
CHLs		<30	
PCBs	270	360±280	120-1100

A changes in air concentration with temperature were apparent for total PCBs and HCBz and not for HCHs or DDTs. The temperature - dependent air concentrations for PCBs, and HCBz may indicate on revolatilization of these chemicals from the surface matrix around Gdańsk.

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