

CONCENTRATION LEVELS OF ENDOCRINE DISRUPTING CHEMICALS IN ENVIRONMENTAL MEDIA OF KOREA

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Introduction

As the public is more concerned about endocrine disrupting chemicals (EDCs), the Ministry of Environment in Korea has designed and established a mid- and long-term research plan on EDCs. Since 1999, the National Institute of Environmental Research has investigated the impact of EDCs on the natural ecosystem and carried out the field test for environmental monitoring.

The goal of this study was to measure the contamination level of EDCs in a variety of environmental media, such as water, sediment, soil and air and to provide a basis for the sound management of EDCs and policy-making for the control of EDCs in Korea. Environmental monitoring sites were selected at representative sites through the nation.

In 2002, 310 samples were collected from 122 sites of water, sediment, soil and air. The target EDCs examined were 93 chemicals in 45 chemical groups including Dioxin, coplanar PCBs, PCBs. Results show that 46 chemicals (31 chemical groups) including dioxins were detected in at least one environmental medium, while 47 chemicals including aldrin were not detected in any environmental media. In this study, the results of the fourth year of environmental monitoring are reported.

Methods and Materials

Sampling: Monitoring sites were selected from representative sites throughout the nation. The numbers of sites investigated are 43 for water, 11 for sediment, 33 for the air, 35 for soil. Water, sediment and soil samples were collected twice per year during spring and autumn, and air samples were collected in each season.

Preparation and quantification: Each environmental material was sampled and analyzed by the

standard methods established by National Institute Environmental Research (NIER)¹. Dioxins and coplanar PCBs were analyzed using HRGC/HRMS. Amitrole, methomyl, benomyl and carbofuran were quantified using LC/MS. Other chemicals were quantified using GC/MS.

Table 1. Investigated chemicals for environmental monitoring (IV)

Chemicals List (93chemicals in 45chemical group)		
1	Dioxins	23 Chlordane (2) cis-chlordane, trans-chlordane
2	Co-planar PCBs (12)	24 Octachlorostyrene
3	PCBs (10)	25 Atrazine
4	Alkyl phenol (8) 4-n-Butyl phenol, 4-t-Butyl phenol 4-n-Pentyl phenol, 4-n-Hexyl phenol 4-n-Heptyl phenol, 4-n-Octyl phenol 4-t-Octyl phenol, Nonyl phenol	26 Organo chlorinated Pesticides(10) Methoxychlor, Dicofof, Hexachlorbenzene Endrin, Heptachlor, Heptachlor epoxide, Oxychlordane, Trans-Nonachlor, Aldrin, Dieldrin
5	Phthalates (8) DEP, DEHP, DprP, DBP, DPP, DHP, DCHP, BBP	27 Metribuzin
6	Di-2-ethylhexyl adipate	28 Carbaryl
7	Benzo(a)pyrene	29 Alachlor
8	Bisphenol A	30 Ethylparathion
9	2,4-Dichlorophenol	31 Malathion
10	Benzophenone	32 Nitrofen
11	4-nitrotoluene	33 Trifluralin
12	n-Butyl benzene	34 Cypermethrin
13	Benomyl	35 Fenvalerate
14	1,2-Dibromo-3-chloropropane (DBCP)	36 Permethrin
15	Pentachlorophenol(PCP)	37 Amitrole
16	2,4,5-Trichlorophenoxy acetate (2,4,5-T)	38 Simazine
17	2,4-Dichlorophenoxy acetate (2,4-D)	39 Vinclozoline
18	17-β-Estradiol	40 Methomyl
19	Organo tins (6) Monobutyl Tin, Dibutyl Tin Tributyl Tin, Monophenyl Tin Diphenyl Tin, Triphenyl Tin	41 DDT (6) p,p'-DDT o,p'-DDT p,p'-DDE o,p'-DDE p,p'-DDD o,p'-DDD
20	Hexachlorocyclohexane (HCH) (4) α-HCH, β-HCH, γ-HCH, δ-HCH	42 Cyhalothrin
21	Carbofuran	43 Dimethoate
22	Endosulfan (3) Endosulfan I, Endosulfan II, Endosulfan Sulfate(SO ₂ form)	44 Fenitrothion 45 Molinate

Results and Discussion

The variation of the number of chemicals that surveyed and detected in each year since 1999 were summarized in Table 2^{2,3,4,5}. 28 chemicals among 87 chemicals in 1999, 32 chemicals among 90 chemicals in 2000, 32 chemicals among 94 chemicals in 2001, and 46 chemicals among 93 targeted EDCs in 2002 were detected at least in one environmental medium.

Table 2. Annual trends of number of chemicals in this survey

year	No. of surveyed chemicals	No. of detected chemicals
1999	37group 87chemicals	13group 28chemicals
2000	37group 90chemicals	21group 32chemicals
2001	40group 94chemicals	24group 32chemicals
2002	45group 93chemicals	31group 46chemicals

Compared with the year of 2001, 12 pesticides such as ethylparathion, 4 industrial chemicals such as DHP, and 2 byproducts were newly detected, but atrazine, malathion, permethrin, vinclozolin were not detected in 2002. The concentration ranges of each chemical detected in this investigation are summarized in Table 3. The data include the names of chemicals and their corresponding concentration ranges of EDCs detected from the samples of water, sediment, soil and air.

Table 3. Detected chemicals and its concentration in each media (The number in the bracket represents the ratio of sites where the chemicals were detected to the total number of sites.)

Chemicals		Detection range ¹⁾			
		Water (□/L)	Sediment (□/□)	Soil (□/□)	Air (ng/N□)
1. Dioxins (I-TEQ) ²⁾		0~1.373 (36/43) ³⁾	0~0.012 (4/11)	0~0.069 (12/35)	0.019~0.875 (33/33)
2. Benzo(a)pyrene		ND ⁴⁾	ND	ND~175.4 (6/35)	0.04~1.11 (33/33)
3. Hexachlorobenzene*		ND	ND	ND~1.32 (6/35)	ND~0.88 (25/33)
4. Bisphenol A		ND~0.262(30/43)	ND~1.0 (5/11)	ND~1.9 (10/35)	-
5. Nonylphenol		ND~0.31(28/43)	<0.5~1.4 (11/11)	ND~6.4 (31/35)	-
6. Phthalates	DEP	ND~0.5 (10/43)	ND	- ⁵⁾	ND~2 (29/33)
	DEHP	ND~0.3 (1/43)	ND~107 (8/11)	-	20~303 (33/33)
	DprP*	ND~0.2 (1/43)	ND	-	ND

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	DBP	ND~1.1 (16/43)	ND~14 (4/11)	-	4~35 (33/33)
	DHP*	ND~0.2 (1/43)	ND~<10 (3/11)	-	ND
	BBP*	ND	ND~<10 ⁶ (4/11)	-	3~12 (33/33)
7. Di-2-ehytylhexyl adipate		ND~0.4 (1/43)	ND~195 (8/11)	-	2~50 (33/33)
8. PCBs		ND	ND~3.9 (3/11)	ND~2.6 (10/35)	-
9. Coplanar PCBs*		ND~0.048 (40/43)	ND~0.004 (8/11)	ND~0.023 (26/35)	0.002~0.054 (33/33)
10. Alachlor		ND~0.16 (14/43)	ND~<0.5 (1/11)	ND~0.7 (4/35)	-
11. Amitrole		ND~2.1 (4/43)	ND~1.2 (5/11)	ND~1.1 (1/35)	-
12. Benomyl		ND~1.2 (33/43)	ND~0.6 (2/11)	ND~17.8 (19/35)	-
13. Benzophenone		ND~0.17 (4/43)	ND	ND~0.3 (1/35)	-
14. Carbofuran*		ND~0.2 (8/43)	ND	ND~3 (4/35)	-
15. Carbaryl		ND~<0.2 (2/43)	ND	ND~2 (1/35)	-
16. DBCP		ND	ND~1 (1/11)	ND~19 (6/35)	-
17. Endosulfan sulfate		ND	ND	ND~27.93 (3/35)	-
18. Ethyl-parathion*		ND	ND	ND~2 (1/35)	-
19. Pernitrothione*		ND	ND	ND~1 (1/35)	-
20. Heptachlor*		ND	ND	ND~0.87 (1/35)	-
21. Methomyl		ND~2.9 (11/43)	ND	ND~1 (2/35)	-
22. Molinate*		ND~0.05 (2/43)	ND	ND	-
23. Simazine		ND~0.09 10/43)	ND	ND~0.7 (3/35)	-
24. Trifluralin*		ND	ND	ND~<0.5 (1/35)	-
25. n-Butylbenzene		ND~0.03 (1/43)	ND~1 (1/11)	ND~8 (6/35)	-
26. 2,4-D		ND~0.236 (5/43)	ND	ND	-
27. 2,4,5-T		ND~0.318 (6/43)	ND	ND	-
28. Organo tin	TBT	ND~0.004 (5/43)	ND~5.8 (1/11)	ND~7.3 (1/35)	-
	MBT*	ND~0.009 (8/43)	ND	ND~0.7 (4/35)	-
29. DDT	p,p'-DDT*	ND	ND	ND~64 (2/35)	-
	o,p'-DDT*	ND	ND	ND~<5 (1/35)	-
	p,p'-DDE*	ND	ND	ND~10 (1/35)	-
	p,p'-DDD*	ND	ND	ND~72 (2/35)	-
30. trans-Nonachlor*		ND	ND	ND~0.59 (4/35)	-
31. trans-Chlordane*		ND	ND	ND~2.60 (1/35)	-

1) Concentration : annual mean value

2) Unit of dioxins : pg-TEQ/ℓ(water), pg-TEQ/dry·g(sediment and soil), pg-TEQ/Nm³(air)

3) No. of detected sites/No. of investigated sites

4) ND: not detected, 5) -: not investigated, 6) < (detection limit): below detection limit

* Newly detected chemicals in 2002

In water, dioxin, bisphenol A, nonylphenol, coplanar PCBs and benomyl were major detected chemicals. Nonylphenol, DEHP, do-2-ethyladipate and coplanar PCBs were detected most of the sediments. In soil sample, most of detected chemicals showed local distribution pattern and only nonylphenol and coplanar PCBs were measured most of the sites.

Regionally, Shiwa, Ulsan and Yecheon industrial area showed higher concentration of dioxin, coplanar PCBs, and bisphenol A than other regions in water samples. Concentration levels of each chemical in these areas were 0.144~1.373 pg-TEQ/l, 0.012~0.048 pg-TEQ/l, 0.262~0.232 μ /L, respectively. In sediments samples, DEHP was the only chemicals that has a regional difference. DEHP concentration level of the Nakdong river was 81~107 μ /L, while other areas were 10~44 μ /L. In soil samples, coplanar PCBs was the only chemical that has a regional difference. Coplanar PCBs concentration levels of the Yecheon and Ulsan industrial area were 0.022~0.023 pg-TEQ/L respectively, while other regions were 0.001~0.008pg-TEQ/L.

In air, dioxin, phthalates, benzo(a)pyrene di-2-ethylhexyl adipate showed a relatively higher level in the metropolitan area, while the average concentration of dioxins in the air decreased every year from 0.425pg-TEQ/Nm³ of 1999 to 0.324pg-TEQ/Nm³ of 2000, 0.287pg-TEQ/Nm³ of 2001 and 0.222pg-TEQ/Nm³ of 2002, respectively.

For the proper control of EDCs, continuous monitoring needs to be performed and these results would provide a sound and solid basis for proper decision-making of EDCs management.

References

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