

CONCENTRATION LEVELS OF ENDOCRINE DISRUPTING CHEMICALS IN ENVIRONMENTAL MEDIA OF KOREA

Kyunghee Choi, Daeil Kang, Junheon Yoon, Choong Lee, Sunghwan Jeon and Jingyun Na

Department of Environmental Risk Research, National Institute of Environmental Research,
Environmental Research Complex, Kyungseo-dong, Seo-gu, Incheon, 404-170, Korea

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 tests 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 the air, to provide a basis for the sound management of EDCs and policy-making for the control of EDCs in Korea. The targeted chemical compounds for monitoring were 87 chemicals in 1999, 90 chemicals in 2000 and 94 chemicals in 2001. The results of each year of environmental monitoring are reported..

Methods and Materials

Monitoring sites were selected from representative sites throughout the nation. The numbers of sites investigated are 43 for water, 11 for sediment, 24 for the air, 35 for soil and 31 for biota. Each environmental material was sampled and analyzed following the standard methods established by National Institute Environmental Research (NIER)¹.

Results and Discussion

Results on the concentration ranges of each chemical detected in this investigation are summarized in Table 1-4^{2,3,4}. The data include the names of chemicals and their corresponding concentration ranges of EDCs measured from the samples collected as of water, sediment, soil and air. 28 chemicals among 87 chemicals measured in 1999, 32 chemicals among 90 chemicals measured in 2000 and 32 chemicals among 94 targeted EDCs in 2001 were detected at least in one environmental medium.

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 and 0.287pg-TEQ/Nm³ of 2001. The samples from water and soil detected in 2000 and 2001 showed higher levels than those measured in 1999, while relatively low levels of EDCs were observed in sediment samples

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.

Table 1. Trend of detected EDCs concentrations in water (unit : µg/L)

| Chemicals | 1999 Range (No. of detected sites) | 2000 Range (No. of detected sites) | 2001 Range (No. of detected sites) |
|-----------|--|--|--|
| Benomyl | ND-2.8 (22/43) | ND-0.4 (28/43) | ND |

| | | | |
|-------------------------------|---------------------|---------------------|------------------|
| 4- <i>n</i> -Pentyl phenol | 0.005-0.362 (43/43) | ND | ND |
| 4- <i>n</i> -Heptyl phenol | ND-0.059 (40/43) | ND | ND |
| 4- <i>n</i> -Octyl phenol | ND | ND-0.038 (3/43) | ND |
| 4- <i>t</i> -Octyl phenol | ND-0.333 (5/43) | ND-0.111 (6/43) | ND |
| Nonyl phenol | 0.04-5.88 (43/43) | 0.01-0.91 (43/43) | ND-0.98 (37/43) |
| Pentachlorophenol | ND-0.121(1/43) | ND | ND |
| Di-2-ethylhexyl phthalate | ND-2.0(20/43) | ND-3.1 (17/43) | ND-3.5 (17/43) |
| Diethyl phthalate | ND-0.5 (3/43) | ND-0.8 (16/43) | ND |
| Di- <i>n</i> -butyl phthalate | ND-3.6 (23/43) | ND-2.9 (37/43) | ND-0.5 (15/43) |
| Di-2-ethylhexyl adipate | ND | ND-1.1 (11/43) | ND |
| Benzophenone | ND-0.05 (7/43) | ND-0.11 (6/43) | ND-0.04 (3/43) |
| Bisphenol A | 0.006-0.976 (43/43) | ND-0.411 (35/43) | ND-1.172 (29/43) |
| Alachlor | ND | ND-0.01 (13/43) | ND-0.07 (19/43) |
| Amitrole | ND-0.3 (6/43) | ND-0.4 (5/43) | ND-3.8 (13/43) |
| Atrazine | ND | ND-0.01 (2/43) | ND-0.49 (2/43) |
| Carbaryl | ND | ND-0.5 (5/43) | ND-0.2 (3/43) |
| Malathion | ND | ND-0.06 (9/43) | ND-0.14 (3/43) |
| Methomyl | - | - | ND-0.2 (4/43) |
| Nitrofen | ND | ND-0.06 (1/43) | ND |
| Permethrin | ND | ND-0.8 (5/43) | ND-0.5 (1/43) |
| Simazine | - | - | ND-0.10 (3/43) |
| DBCP | ND | ND | ND-0.03 (1/43) |
| 2,4,5-T | ND | ND-0.015 (4/43) | ND |
| 2,4-D | ND | ND-0.017 (6/43) | ND-0.006 (1/43) |
| Dioxins (pg-TEQ/L) | 0-0.502 (37/43) | 0.001-1.061 (43/43) | 0-0.946 (42/43) |

Table 2. Trend of detected EDCs concentrations in sediment (unit : $\mu\text{g}/\text{kg}$)

| Chemicals | 1999 Range (No. of detected sites) | 2000 Range (No. of detected sites) | 2001 Range (No. of detected sites) |
|-------------------------------|--|--|--|
| Bisphenol A | ND-5.7 (7/11) | ND-0.6 (8/11) | ND-0.9 (7/11) |
| 4- <i>n</i> -Heptyl phenol | 0.6-4.4 (11/11) | ND-0.5 (2/11) | ND |
| Nonylphenol | 6.0-119.1 (11/11) | 6.0-37.4 (11/11) | 0.5-5.8 (11/11) |
| Di-2-ethylhexyl phthalate | ND-2044.96 (7/11) | ND-193 (6/11) | ND-117 (8/11) |
| Diethyl phthalate | ND-77.45 (7/11) | 19-35 (11/11) | ND |
| Di- <i>n</i> -butyl phthalate | ND-32.46 (3/11) | ND | ND |
| Benzo(a)pyrene | ND | ND-3 (5/11) | ND-1.0 (1/11) |
| Benzophenone | ND | ND | ND-1.8 (1/11) |
| <i>n</i> -butylbenzene | ND | ND | ND-1 (1/11) |
| Amitrole | ND-3.69 (5/11) | ND-1 (2/11) | ND-1.8 (4/11) |
| Benomyl | ND-5.947 (4/11) | ND-1.0 (4/11) | ND-0.7 (6/11) |
| Carbaryl | ND | ND | ND-1 (5/11) |
| 2,4,5-T | ND | ND-0.7 (1/11) | ND |
| DBCP | ND | ND | ND-1 (6/11) |
| PCBs | ND | ND | ND-0.5 (1/11) |

| | | | |
|-------------------------|----------------|----------------|----------------|
| Tributyl tin | ND-5.96 (1/11) | ND-3.82 (1/11) | ND-0.04 (1/11) |
| Dioxins (pg-TEQ/ dry-g) | 0-0.984 (5/11) | 0-0.244 (7/11) | 0-0.537 (8/11) |

Table 3. Trend of detected EDCs concentrations in soil (unit : /kg)

| Chemicals | 1999 Range (No. of detected sites) | 2000 Range (No. of detected sites) | 2001 Range (No. of detected sites) |
|---------------------------|--|--|--|
| Bisphenol A | ND-54.1 (19/35) | ND-6.9 (29/35) | ND-2.4 (29/35) |
| Nonylphenol | ND | ND-13.0 (32/35) | ND-7.4 (28/35) |
| Benzo(a)pyrene | ND | ND-9.0 (17/35) | ND-7.8 (7/35) |
| Benzophenone | ND-0.695 (2/35) | ND | ND |
| Alachlor | ND | ND-0.10 (2/35) | ND-0.8 (4/35) |
| Amitrole | ND-13.9 (15/35) | ND-4.0 (12/35) | ND-0.7 (12/35) |
| Atrazine | ND | ND | ND-1.0 (1/35) |
| Benomyl | ND-8.2 (12/35) | ND-96.1 (28/35) | ND-23.2 (20/35) |
| Carbaryl | ND | ND-2 (4/35) | ND-2 (2/35) |
| Endosulfan sulfate | - | - | ND-14.00 (3/35) |
| Methomyl | - | - | ND-1 (2/35) |
| Simazine | - | - | ND-1.1 (3/35) |
| Vinclozolin | - | - | ND-0.5 (1/35) |
| 2,4,5-T | ND | ND-1.0 (2/35) | ND |
| 2,4-D | ND | ND-0.9 (2/35) | ND |
| DBCP | ND | ND-5 (4/35) | ND-6 (12/35) |
| n-butylbenzene | ND | ND | ND-2 (10/35) |
| PCBs | ND-2.4 (3/35) | ND-1.2 (5/35) | ND-1.7 (5/35) |
| Dioxins (pg-TEQ/dry-g) | 0-22.439 (31/35) | 0-40.478 (33/35) | 0-43.333 (34/35) |

Table 4. Trend of detected EDCs concentrations in the air (unit : ng/Nm³)

| Chemicals | 1999 Range (No. of detected sites) | 2000 Range (No. of detected sites) | 2001 Range (No. of detected sites) |
|------------------------------------|--|--|--|
| Hexachlorobenzene | ND-0.75 (23/24) | 0.04-3.79 (26/26) | 0.02-0.39 (26/26) |
| Benzo(a)pyrene | 0.26-2.55 (24/24) | 0.09-2.15 (26/26) | 0.10-1.66 (26/26) |
| Di-2-ethylhexyl adipate | ND-91 (23/24) | 1-8 (26/26) | 1-27 (26/26) |
| Diethyl phthalate | ND-11 (21/24) | ND-3 (21/26) | ND-1 (5/26) |
| Dipropyl phthalate | ND | ND | ND-1 (3/26) |
| Di-2-ethylhexyl phthalate | 15-899 (24/24) | 18-1041 (26/26) | 14-268 (26/26) |
| Di-n-butyl phthalate | 4-216 (24/24) | 4-20 (26/26) | 4-131 (26/26) |
| Butyl benzyl phthalate | ND-6 (12/24) | 2-8 (26/26) | 2-11 (26/26) |
| Dioxins (pg-TEQ/ Nm ³) | 0-4.448 (23/24) | 0.013-1.664 (26/26) | 0.012-1.496 (26/26) |

References

1. NIER. (1999) Analytical Methods on EDCs.
2. NIER. (1999) Annual Report of EDCs Research Project.
3. NIER. (2000) Annual Report of EDCs Research Project.
4. NIER. (2001) Annual Report of EDCs Research Project.