

LEVELS IN BIOTIC COMPARTMENTS

ACCUMULATION OF POLYCHLORINATED BIPHENYLS IN AMPHIBIANS FROM THE BASINS OF MAJOR RIVERS IN S.KOREA

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Introduction

Even though production and use of polychlorinated biphenyls (PCBs) was prohibited for nearly 30 years, their persistency and lipophilicity have lead to vast accumulation in the environment¹. They also can be easily accumulated through the food chain and magnified up to millions of times in animal tissue². As a part of grand project to monitor the accumulation levels of endocrine disrupting chemicals, we determined PCBs in amphibians from the basins of major rivers in S.Korea. We selected 29 sampling sites from the basins of major rivers and two sites from well-known wetlands. We determined accumulation levels of 62 congeners of PCBs and classified these data by homologs. The total PCB levels ranged from 0.080 to 0.654 ng/g wet weight. The most abundant homologs were hexa-, and hepta-CBs for leopard frogs and tetra- and penta-CBs for bullfrogs.

Methods and Materials

Sampling amphibians: Amphibians were collected from August 1999 to June 2000 from sites located along the four major rivers, several small scaled rivers and two well-known wetlands. The locations are illustrated in another issue³ of Organohalogen Compounds and site names are listed in Table 1. The muscular tissue of amphibians were separated and stored at below -20 °C before analysis. Standard materials and analysis procedure were described in another issue.³

Results and Discussion

The recovery rates obtained from the standard reference material CARP-1 was in the range of 84% to 133% with standard deviations ranged from 0.9 to 8.9 %. Total PCBs and homolog levels in the muscular tissue of leopard frogs and bullfrogs are listed in Table 1 and Table 2, respectively. These are also illustrated in Fig. 1, 2, and 3. The total PCBs levels ranged from 0.080 to 1.481 ng/g (wet weight) for leopard frogs and 0.083 to 0.375 ng/g for bullfrogs. The average total PCB level is 0.331 ± 0.271 ng/g and 0.167 ± 0.079 ng/g for leopard frogs and bullfrogs, respectively. In comparison with the average total PCBs level in fresh water fishes,³ e.g. 8.1 ± 8.9 ng/g for crucians, total PCBs levels by sites are much lower and more evenly distributed in amphibians. Hexa-, and hepta-CBs showed highest levels for leopard frogs and occupied 54.4 % of the total PCBs. For bullfrogs, tetra- and penta-CBs were highest homologs and occupied 68.1 % of the total PCBs. This trend is illustrated in Fig. 1. In the muscular tissue of crucians collected from the same sites, penta- and hexa-CBs were the major homologs.³

The Nam River (site no. 10) showed the highest contamination level, however, much lower than the total PCBs levels observed in fresh water fishes collected from the same sites.³ The total PCBs levels in

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carcasses of leopard frogs collected from Green Bay/lower Fox River ecosystem, heavily contaminated area with PCBs and dioxins, located in Wisconsin, U.S.A. were ranged from 2.8 to 151.9 ng/g wet body weight.⁴ The highest concentration observed in this study is lower than the lowest concentration observed in Wisconsin.

Acknowledgements

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References

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3. Jeong, G.H., Kim, D.Y., Kim, M.O., Lee, J.Y., and Kim, Y.B. (2001) Organohalogen Compounds, 51, 344-347.)
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Table 1. Total PCBs and homolog levels in the muscular tissue of leopard frogs. ng/g (wet weight)

	Site No. and Name	The number of chlorine atoms in the polychlorinated biphenyls										Total PCBs
		1	2	3	4	5	6	7	8	9	10	
Han River	1 Uiam-D	nd	0.068	0.104	0.023	0.012	0.074	0.036	nd	nd	nd	0.316
	2 Seom-R	nd	0.028	0.085	0.030	0.038	0.165	nd	nd	nd	0.014	0.361
	3 Bokha-S	nd	nd	0.005	0.005	0.008	0.030	nd	0.049	nd	nd	0.100
	4 Kyungan-S	nd	0.111	0.007	nd	0.047	nd	0.040	nd	nd	0.006	0.210
	5 Paldang-D	nd	nd	0.007	0.063	0.041	0.075	0.094	0.286	nd	nd	0.567
Nakdong River	7 Koomee	nd	nd	nd	0.022	0.079	0.255	0.228	nd	nd	0.020	0.604
	8 Koryoung	nd	nd	0.028	0.008	0.068	0.184	0.366	nd	nd	nd	0.654
	9 Kumho-R	nd	0.022	nd	0.015	0.051	0.146	0.076	nd	nd	nd	0.311
	10 Nam-R	nd	0.156	0.630	0.081	0.040	0.233	0.326	nd	nd	0.016	1.481
	11 Namji	0.095	nd	0.037	0.023	0.088	0.201	0.122	nd	nd	nd	0.566
	12 Moolgum	nd	nd	nd	0.009	0.048	0.144	0.281	0.047	0.053	nd	0.582
	13 Nakdong-E	nd	0.013	nd	nd	0.033	0.064	0.157	0.040	0.023	0.009	0.339
Kum River	14 Dachung-D	nd	nd	0.048	0.033	0.041	0.063	0.086	nd	nd	0.002	0.272
	15 Moosim-S	nd	nd	0.027	nd	0.032	0.100	0.051	nd	nd	nd	0.209
	16 Kongjoo	nd	nd	0.035	nd	0.045	0.066	0.010	nd	nd	0.025	0.182
	17 Booyeo	nd	nd	0.060	nd	0.029	0.158	0.143	nd	nd	nd	0.390
Young-san R.	18 Damyang-D	nd	0.018	nd	nd	0.030	0.085	0.079	nd	nd	0.012	0.222
	19 Kwangjoo-S	nd	nd	0.035	0.028	0.048	0.053	0.004	nd	nd	nd	0.169
	21 Mooan	nd	nd	nd	0.023	0.102	0.095	0.042	nd	nd	0.006	0.268
	22 Kosan	nd	0.026	0.008	nd	0.064	0.061	0.036	nd	0.006	nd	0.202
	23 Oncheon-S	nd	0.049	0.098	0.038	0.038	0.039	nd	nd	0.008	nd	0.269

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Other small scaled Rivers	24	Myungchon	nd	nd	nd	nd	0.008	0.082	0.174	0.051	nd	0.015	0.331
	25	Yangyang	nd	nd	0.027	0.009	0.028	0.068	nd	nd	nd	nd	0.131
	26	Hadong	nd	nd	0.010	nd	0.036	0.041	0.035	nd	nd	nd	0.122
	27	Samcheok	nd	nd	0.024	nd	0.047	0.085	0.025	0.023	nd	nd	0.204
	28	Kangnung	nd	nd	nd	0.033	0.019	0.023	0.006	nd	nd	nd	0.080
Wetlands	29	Hwangku-T	nd	0.029	0.037	0.024	0.024	0.075	0.004	nd	nd	nd	0.192
	30	Woopo	nd	nd	0.007	nd	0.092	0.079	nd	nd	nd	nd	0.178
	31	Joonam	nd	nd	nd	0.055	0.126	0.077	0.161	nd	nd	0.009	0.428
Total Homolog			0.095	0.520	1.319	0.521	1.358	2.828	2.583	0.496	0.093	0.133	9.938

nd: none detected. D: Dam; R: River; S: Stream; E: Estuary; T: Tributary

Table 2. Total PCBs and homolog levels in the muscular tissue of bullfrogs. ng/g (wet weight)

	Site No. and Name	The number of chlorine atoms in the polychlorinated biphenyls										Total PCBs	
		1	2	3	4	5	6	7	8	9	10		
Han River	1 Uiam-D												
	2 Seom-R												
	3 Bokha-S	nd	nd	nd	0.099	0.056	0.016	0.027	0.030	0.003	nd	0.231	
	4 Kyungan-S	nd	nd	nd	0.132	0.048	0.018	0.007	0.017	0.005	0.002	0.228	
	5 Paldang-D	nd	nd	nd	0.077	0.087	0.040	0.031	0.031	0.006	nd	0.271	
	6 Anyang-S	nd	nd	0.018	nd	0.039	0.095	0.015	nd	nd	nd	0.167	
Nakdong River	7 Koomee	nd	nd	nd	0.057	0.079	0.026	0.008	0.015	0.003	0.004	0.192	
	8 Koryoung	nd	nd	nd	0.042	0.036	0.015	0.005	0.021	0.003	0.005	0.126	
	9 Kumho-R	nd	nd	nd	0.081	0.086	0.020	0.013	0.010	0.009	nd	0.219	
	10 Nam-R	nd	nd	nd	0.086	0.052	0.018	0.013	0.017	0.007	0.011	0.203	
	11 Namji	nd	nd	nd	0.037	0.021	0.012	0.009	0.011	0.010	nd	0.099	
	12 Moolgum	nd	nd	nd	0.099	0.222	0.014	0.017	0.012	0.005	0.006	0.375	
	13 Nakdong-E	nd	nd	nd	0.072	0.039	0.016	0.024	0.012	0.013	nd	0.174	
Kum River	14 Dachung-D	nd	nd	nd	0.107	0.036	0.028	0.019	0.021	0.010	nd	0.221	
	15 Moosim-S	nd	nd	nd	0.053	0.062	0.017	nd	0.006	0.005	nd	0.143	
	16 Kongjoo	nd	nd	nd	0.096	0.023	0.035	0.012	0.010	0.006	nd	0.181	
	17 Booyeo	nd	nd	nd	0.184	0.063	0.023	0.012	0.019	0.007	nd	0.308	
Youngsan River	18 Damyang-D	nd	nd	nd	0.216	0.049	0.014	0.007	0.012	0.012	nd	0.312	
	19 Kwangjoo-S	nd	nd	nd	0.072	0.043	0.018	0.006	nd	0.002	0.004	0.147	
	20 Najoo	nd	nd	nd	0.208	0.041	0.035	0.022	0.008	0.006	0.006	0.324	
	21 Mooan	nd	nd	nd	0.032	0.019	0.014	0.012	0.015	0.006	0.002	0.100	
Other small-scaled Rivers	22 Kosan	nd	nd	nd	0.118	0.052	0.014	0.008	0.016	0.004	nd	0.212	
	23 Oncheon-S	nd	nd	nd	0.070	0.036	0.027	0.027	0.028	0.003	0.007	0.197	
	24 Myungchon	nd	nd	nd	0.014	0.024	0.030	0.024	0.025	0.014	0.005	0.136	

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	26	Hadong	nd	nd	nd	0.062	0.024	0.017	0.011	0.013	0.007	nd	0.132
	27	Samcheok											
	28	Kangnung											
	29	Hwangku-T	nd	nd	nd	0.014	0.026	0.016	0.012	0.010	0.005	nd	0.083
Wet-lands	30	Woopo	nd	nd	nd	0.017	0.024	0.012	0.019	0.005	0.009	nd	0.086
	31	Joonam	nd	nd	nd	0.031	0.048	0.024	0.015	0.012	0.006	0.004	0.139
Total Homolog			nd	nd	0.018	2.075	1.331	0.612	0.374	0.375	0.165	0.056	5.005

nd: none detected. D: Dam; R: River; S: Stream; E: Estuary; T: Tributary

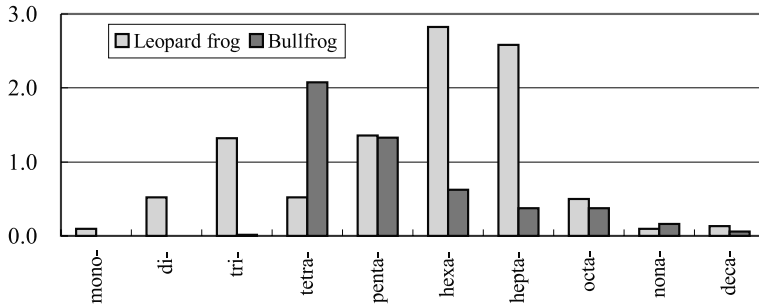


Fig. 1. PCBs homolog pattern in the muscular tissue of leopard frog and bullfrog

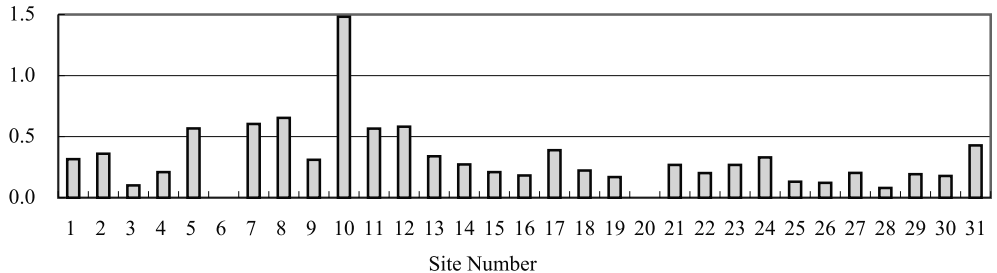


Fig. 2. Total PCBs levels in the muscular tissue of leopard frog (ng/g, wet wt)

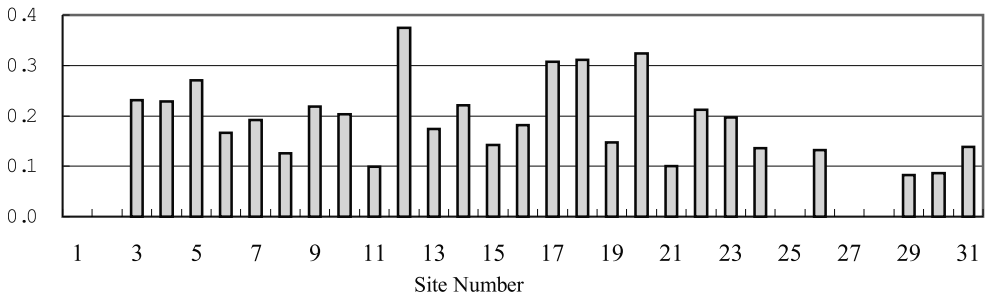


Fig. 3. Total PCBs in the muscular tissue of bullfrogs (ng/g wet weight)