

Accumulation of polychlorinated biphenyls in the freshwater fish, crucian, from the Han River and the Kum River, Korea

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Introduction

Even though polychlorinated biphenyls(PCBs) were prohibited from producing and using for a long time, it is still identified in the every environmental media including biota. Since PCBs are lipophilic and persistent, they concentrate readily in the tissue and accumulate exponentially as they move through the food chain. Crucian (*Carassius auratus*) is most widely living freshwater fish in Korea. So crucian was selected as a representative freshwater fish in this study to determine the accumulation level and distribution characteristics of PCBs.

Bordajandi et al.¹ reported total PCB levels of common trout collected from the River Turia, Spain. The mean, minimum and maximum levels of total PCB of that freshwater fish were 6.86, 5.14 and 9.16 ng/g wet weight. Manirakiza et al.² determined PCB levels in selected fish species from Lake Tanganyika, Brundi, Africa. They reported the levels of PCBs found were very low. The PCB levels were ranged from 24.3±11 ng/g fat for *Chrysichthys sianenna* to 106.4±24.5 ng/g fat for *Oreochromis niloticus*. PCB 153, 149 and 138 were the main congeners in their data. Another report by Miglioranza et al.³ selected 5 different fish species and determined PCBs in different trophic levels from a shallow lake in Argentina. They found pre-spawning female of *O. jenynsi*, a low-fat fish, accumulated the highest PCB levels in ovary, followed by liver and muscle. They also reported main congener groups in liver and muscle were tetra-, penta- and hexa-chlorinated while in ovary penta-, hexa- and hepta.

In this study, we attempted to investigate the accumulation profile of individual PCB congeners in the muscle of freshwater fish crucian from the two major rivers, the Han River and Kum River, in Korea.

Methods and Materials

Sampling was done from April to June, 2002 at 6 sampling sites located along the Han River and Kum River illustrated in Fig. 1. Only muscle part of several individuals were mixed and homogenized to prepare a pooled sample and stored at below -20 °C before they were freeze dried. Total 62 congeners were determined. Standard materials and analysis procedure were described in detail in another issue.⁴ Recovery rates obtained from the certified reference material CARP-II (Wellington Lab. Inc.) were ranged from 70.0±3.6% to 82.7±5.9% from triplicate determinations. BP-MS (Wellington Lab. Inc.) containing 62 congeners was used as a PCB standard material. MBP-CG (Wellington Lab. Inc.) containing 10 ¹³C-substituted congeners was used as an internal standard for quantification. Perylen d₁₂ (Dr. Ehrenstorfer) was added as another internal standard at the last part of the cleanup process. Calibration curves were constructed by the ratio of peak area obtained with GC-MSD system from five steps of different concentrations of the standard solution and internal standard solution. The relative response factor was used to calculate the PCB levels.

Results and Discussion

Among 62 PCB congeners determined in this study, only 22 congeners were detected at least at one site and 10 congeners were detected only at one site. The principal congener was PCB 153 and main congener groups were penta- and hexa-chlorinated biphenyls. This type of result is a general case for PCBs in fish.^{1,2,3} Table 1 shows PCB homolog levels and total PCBs from the six sampling sites. Mono-, di-, octa-, nona- and deca-chlorinated biphenyls were not detected at any sampling site. Tri-chlorinated biphenyls were detected only at one site, Booyeo along the Kum River. The highest PCB level was found at Booyeo and followed by Kyungan stream, 3.26 and 3.14 ng/g wet weight respectively. These two sites account for 62.2% of total PCBs for the six sites. The highest level homolog was hexa-chlorinated biphenyls, 4.92 ng/g wet weight and followed by penta-chlorinated biphenyls, 4.19 ng/g wet weight. The proportion of these two homologs is 88.5% of total PCBs for the ten homologs as shown in Fig. 2.

Congener specific distribution pattern is illustrated in Fig. 3. Twenty-two congeners were detected and PCB 153 and PCB 138 were the major congeners in crucian from these two rivers as shown in Fig. 4. These two congeners occupies

around one-third of total PCBs. The other main congeners, which account for another 28.8% of total PCBs, were PCB 110, 101, 118 and 149.

Dachung dam and Booyeo belong to the Kum River system and the other 4 sites belong to the Han River system. Compared with the result⁴ investigated in the year 2000 with the same fish species, total PCB levels were decreased significantly except at Kyungan stream. These results are illustrated in Fig. 5. In order to confirm this descending trend of total PCB levels, more investigations may be necessary in the future.

Acknowledgements

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Table 1. Total PCBs and homolog levels in muscle of crucian. ng/g (wet weight)

Site		The number of chlorine atoms in the polychlorinated biphenyls										Total PCBs
		1	2	3	4	5	6	7	8	9	10	
Han River	Uiam-D	nd	nd	nd	0.06	0.14	0.59	nd	nd	nd	nd	0.79
	Seom-T	nd	nd	nd	nd	0.28	0.74	0.09	nd	nd	nd	1.12
	Bokha-S	nd	nd	nd	0.07	0.19	0.08	nd	nd	nd	nd	0.33
	Kyungan-S	nd	nd	nd	0.23	1.37	1.29	0.25	nd	nd	nd	3.14
Kum River	Dachung-D	nd	nd	nd	nd	1.06	0.59	nd	nd	nd	nd	1.65
	Booyeo	nd	nd	0.35	nd	1.17	1.62	0.13	nd	nd	nd	3.26
Total Homolog		nd	nd	0.35	0.36	4.19	4.92	0.47	nd	nd	nd	10.29

nd: not detected, D: dam, T: tributary, S: stream,

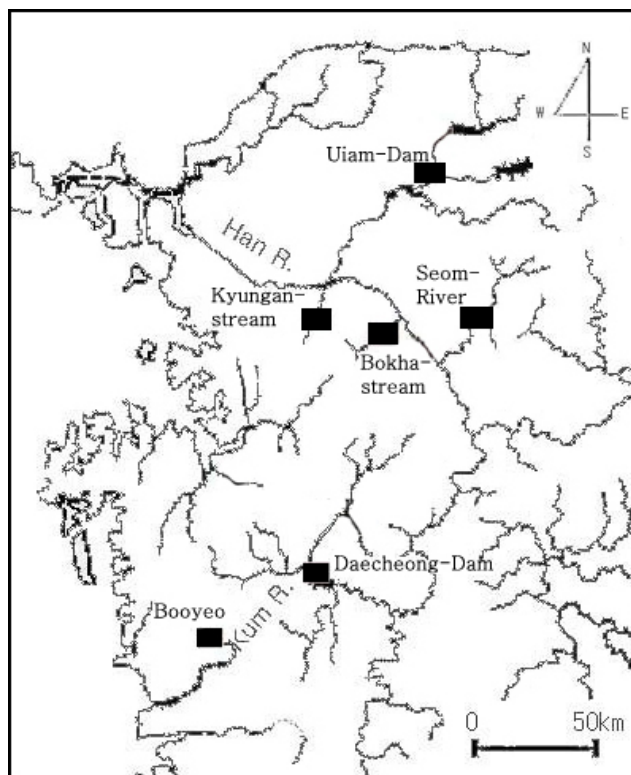


Fig. 1. Locations of sampling sites along the Han and Kum River.
(126° E ~ 128° E, 35.6° N ~ 38.1° N)

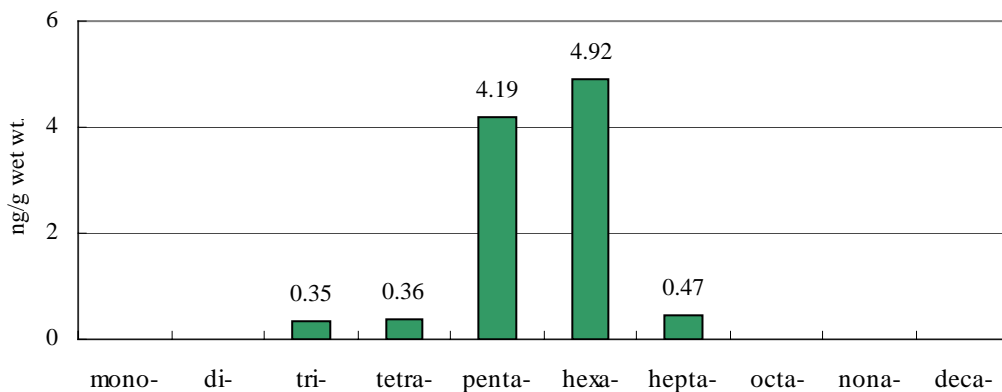


Fig. 2. Homolog specific total PCB levels in curcians from the 6 sampling sites along the Han River and Kum River

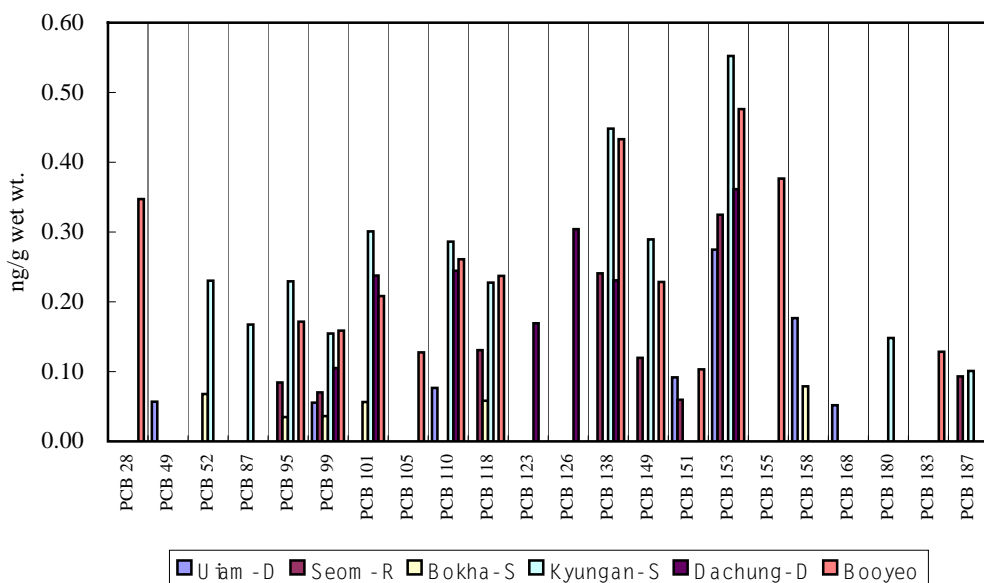


Fig. 3. PCB congener levels in crucians from the 6 sampling sites along the Han River and Kum River

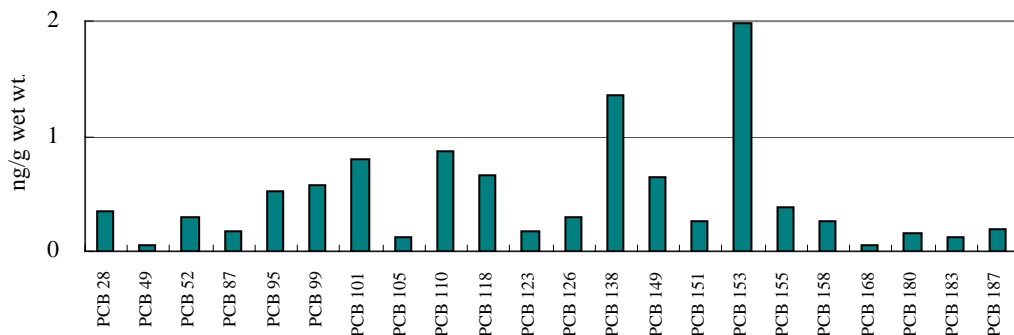


Fig. 4. Congener specific total levels in crucian from the 6 sampling sites along the Han River and Kum River

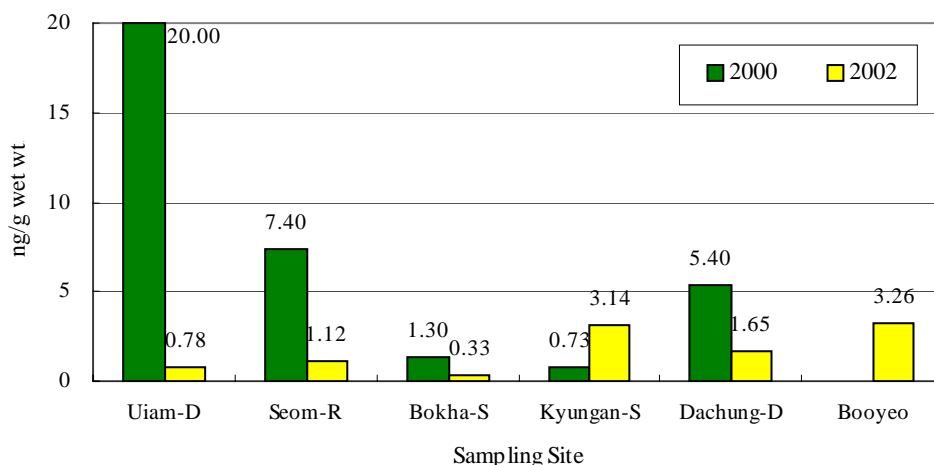


Fig. 5. Total PCB levels in crucian from the 6 sites along the Han River and Kum River in the year 2000 and 2002

References

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