The level of Toxaphene in Korean fish

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Introduction

Persistent Organic Pollutants (POPs) are chemicals that remain unaltered in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of living organisms and are toxic to humans and wildlife. Toxaphene, one of the 12 POPs identified by the United Nations Environment program as requiring urgent attention, was used commonly as a pesticide in 1970s[1]. Exposure to toxaphene can damage the lungs, nervous system, and kidneys, and even cause death. Additionally, studies show that animals which ate food or drank water containing toxaphene had damage to the liver, kidneys, adrenal glands, and immune system[2] . Fortunately, many developed countries started prohibiting its use in 1980s. Because toxaphene is not easily degradable but easily accumulates in fish and mammals, many researchers are still interested in the level of toxaphene in the environment. Elevated levels of toxaphene have also been found in the Arctic environment and toxaphene has become a health hazard to the indigenous people there. It is still the predominant persistent organochlorine species in many ecosystems such as the Great Lakes.

In Korea, the use of toxaphene as a pesticide was prohibited by the Agricultural Chemicals Management Law in 1981. Producing, importing, and using toxaphene and formulations that include more than 1% toxaphene were prohibited by the Hazardous Chemicals Management Law in 1991. However, to date, few researchers have investigated the level of toxaphene in the environment compared with the levels of other 11 POPs. In Korea, researchers have undertaken an Endocrine Disruption Project, an annual nationwide survey of fish samples studying 26 endocrine disruptor groups since 1999. However, they didn't analyze for toxaphene. Therefore we investigated the level of toxaphene in Korean fish samples. The results of the study could encourage other researchers to investigate the level of toxaphene in other environmental compartments including other fish.

Materials and methods

Fish samples were collected in the Korean sea. They were extracted by using an automated Accelerated Solvent

Extractor (ASE 300, Dionex. Co) instead of a traditional soxhlet extraction method. Methylene chloride was used as the extraction solvent. The total extraction time of each sample was about 30 minutes. The conditions of ASE were as the follows: Heating time (6min), Static time (3 min), Flush volume (60%), Purge time (120 sec), Static cycle (3 times), Pressure: (1500 psi), Temperature (125°c). After extraction, fish samples were pretreated with a silica gel clean up procedure. A ThermoElectron TRACE GC gas chromatography coupled with ThermoElectron Polaris MS/MS ion trap mass spectrometry was used to analyze toxaphene using electron ionization mode at 70ev. A DB-XLB capillary column of 60m length and 0.25 mm internal diameter with a 0.25 um film thickness was used in analysis. The oven temperature program in the GC chromatography was: 100°C(2 min), 15°C/min to 150°C, 1.5°C/min to 300°C(25min). The temperature of ion source and line were 200°C and 300°C, respectively. In this study, eight toxaphene congeners were measured: Parlar #26, TMX-1, Parlar #38, Parlar #40, Parlar #41, Parlar #44, Parlar #50, and Parlar #62 because only a few hepta, octa and nonachloro-homologues accumulate in the fatty tissue of fish and mammals [3]. The concentration of each congener in the standard mix ranged from 25ng/mL to 500ng/mL. Five-point calibration curves were constructed.

Results and discussion

The concentrations of toxaphene in Korean fish are reported in Table 1. They ranged from 0.34 ng/g to 1.86 ng/g. The toxaphene concentration in Hairtail, 1.86 ng/g, is the highest of the Korean fish. However, these results are lower than the 0.1mg/kg allowable limit of toxaphene in fish set by the Federal Republic of Germany[4]. This limit is defined as the sum of three specific congeners, Parlar #26, Parlar #50, and Parlar #62. The major contributor among other toxaphene congeners is Parlar #50 and Parlar #26. These two congeners are also major congeners in marine mammals[3]. The dietary intake of toxaphene by consumption of fish was calculated as follows: the average body weight of a Korean adult was set as 60kg, and the daily intake amount of fish for a Korean adult was assumed to be 30g/day. The daily intake of toxaphene by fish consumption for Korean in this study is 0.45 ng/kg bodyweight/day. The TDI of toxaphene in Canada is 0.2ug/ kg bodyweight/day[4]. Based on this result, the level of Toxaphene in Korean fish is considered to be safe. However this conclusion is based on a very limited number and types of fish so we need to continue to study the level of toxaphene in fish and other foods.

Reference

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Table. 1. The level of toxaphene in Korean fish

(unit: ng/g)

No.	Common name	P26	TMX-1	P38	P40	P41	P44	P50	P62	Total
1	Red Seabream	0.05	0.02	0.02	Nd	Nd	0.02	0.25	Nd	0.36
2	Pacific saury	0.24	0.06	0.20	0.03	0.13	0.05	0.22	0.21	1.15
3	Roundnose flounder	0.09	0.03	0.01	0.11	0.05	Nd	0.08	0.05	0.42
4	Salmon	0.55	0.02	0.04	0.20	0.17	0.13	0.58	0.10	1.79
5	Mackerel	0.12	0.07	0.16	0.19	0.22	0.16	0.23	Nd	1.15
6	Yellow corvenia	0.15	0.05	0.09	0.02	0.02	0.04	0.02	Nd	0.39
7	Red tongue sole	Nd	0.08	0.20	0.09	0.07	0.04	0.03	0.05	0.56
8	Pacific Cod	0.09	Nd	0.03	0.01	Nd	0.05	0.15	Nd	0.34
9	Alaska pollack	0.06	0.01	0.04	0.04	0.02	Nd	Nd	0.20	0.37
10	Hairtail	0.19	0.10	0.25	0.27	0.10	0.81	0.81	0.03	1.86
11	Anchovy	0.09	0.05	0.29	0.10	0.05	0.34	0.34	0.12	1.25
12	Atka mackerel	0.03	0.06	Nd	0.09	0.25	0.27	0.27	0.36	1.31
13	Conger eel	Nd	0.15	0.03	0.14	0.10	0.17	0.17	0.03	0.67
	Average									0.89

Nd – non-detect