The levels of PCDD/Fs and DL-PCBs in fishes in Japan
The trend from 1999 to 2005 and present state

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Abstract

In seafood, the average level of PCDD/Fs and DL-PCBs decreased clearly from 1999 to 2005, according to the investigation by The Ministry of Agriculture, Forestry and Fishery (MUFF). But by our analysis, actually the average level of PCDD/Fs and DL-PCBs in the coastal and offshore fishes around the Japanese Islands decreased only a little during these 7 years, and comparatively many of them remain highly contaminated. In addition, some of the deep-sea and imported fishes are also heavily contaminated. According to the estimates of the Ministry of Health, Labor and Welfare, the dietary intake for PCDD/Fs and DL-PCBs also have steadily fallen to 1.2 pg WHO-TEQ/kg bw/day. But the value of the maximum intake for PCDD/Fs and DL-PCBs was more than 3.0 pg WHO-TEQ/kg bw/day in most years between 1999 and 2005. These situations considered, we claim that the Japanese TDI of 4pg WHO-TEQ/kg bw /day should be revised at least 2 pg WHO-TEQ/kg bw/day, and at the same time the Standard Level of PCDD/Fs and DL-PCBs in seafood should be established as soon as possible.

Introduction

Japanese people have traditionally eaten many species of fish as a source of proteins, because the Japanese Islands are surrounded by sea. Today Japanese adults derive approximately 90 percent of their dietary intake for PCDD/Fs and Dioxin-like PCBs (DL-PCBs) from seafood (Fish, Shellfish, Crustaceans, and Marine animals). In this paper, only the fish will be discussed. Lack of analytical estimate regarding the contamination of seafood, particularly fish heavily contaminated by PCDD/Fs and DL-PCBs, makes this study necessary to evaluate the present state of contaminations in fishes, and to select the appropriate kind of fish for everyday diet. Furthermore, this study will ask if the Japanese TDI of 4 pg WHO-TEQ/kg bw/day is effectual for health.

Since 1997, for the safety and sustainable supply of seafood, The Ministry of Agriculture, Forestry and Fishery (MUFF) has been investigating the levels of PCDD/Fs and DL-PCBs in seafood. Data of the investigations from 1999 to 2005 has been published every year. The latest one was published in 2006[1].

Materials and Methods

For this analytical study for the levels of PCDD/Fs and DL-PCBs in fishes, mainly two kinds of materials are used. First, all data from the samples are provided by the MAFF publication[1]of 2006. The primary objective of the MAFF investigation is to estimate the level of PCDD/Fs and DL-PCBs in seafood. The whole samples of seafood are 1,405, in which the fish samples are 926. This sampling is based on the Japanese diet. Each sample is prepared with the edible

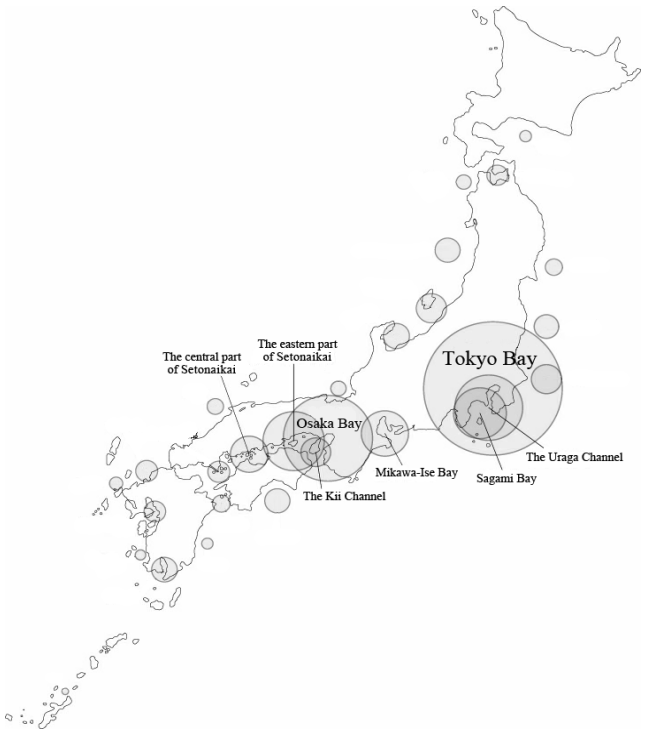
portion of over 10 fish and over 1kg, and then all samples are analyzed.

The second material is the booklet titled "The Dioxins Contaminations in Foods" [2]. It was issued in 2003 by our NGO (PACDED), analyzing the database (it includes 2,303 samples of fishes) of "On the result of the investigations of the levels of PCDD/Fs and DL-PCBs in aquatic animals and plants in the areas of public water" [3] carried out by The Ministry of Environment. This database was made public for the first time in 2001, by demand of PACDED.

Results and Discussions

In "The Dioxins Contaminations in Foods", the sea around the Japanese Islands was divided into 30 sea areas, and then the calculated average levels of PCDD/Fs and DL-PCBs in all fish samples of each sea area, represents the concentration levels of each sea area. These calculations made it clear that the level of PCDD/Fs and DL-PCBs in partially-enclosed sea area is high, particularly Tokyo bay, Osaka bay, Setonaikai and so on. Behind these sea areas, there are big cites having large population and industrial zones (Figure1). Moreover, we found, there are two types of fishes susceptible to contamination with PCDD/Fs and DL-PCBs. First, the high contamination of fish depends on the fat content by percent of fish. So the fishes having this characteristic nature of having high fat which live near the coast and near the mouths of rivers in bays contain generally high concentrations of PCDD/Fs and DL-PCBs, for example, gizzard shad and conger eel (Table 1). Second, relatively big, fatty predatory fishes which are at the upper level of the food-chain have high concentrations, for example, sea bass, yellow tail and scabbard fish (Table 1).

Figure 1. Levels of PCDD/Fs and DL-PCBs in the sea areas



According to the data provided by MAFF between 1999 and 2005, average levels of PCDD/Fs and DL-PCBs in seafood as well as fish continue to decrease. In MAFF data, fishes (927 samples) are divided into two categories; the coastal & offshore fish (623samples) and the deep-sea & imported fish (304 samples). In order to examine the trend of the levels of PCDD/Fs and DL-PCBs in fishes in these two categories, we split the whole data of fishes between 1999 and 2005 into two groups, and compared average concentration of 1999-2002 (273 samples) with that of 2003-2005 (654 samples). Average level in coastal & offshore fishes has not decreased much (from 1.13 to 1.07 pg WHO-TEQ/g fw), and average level in deep-sea & imported fishes has clearly declined. (from 1.24 to 0.84 pg WHO-TEQ/g fw)

(Figure 2). Next, we will examine in fishes of the two categories respectively.

Figure 2. Trend of average levels of PCDD/Fs and DL-PCBs in fishes from1999-2005

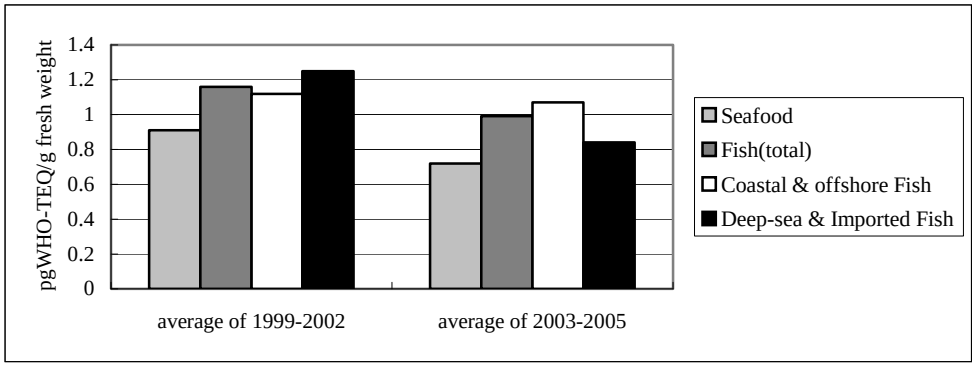


Table 1 shows the results for the common coastal & offshore fishes (all samples are wild) examined individually. Although average levels of PCDD/Fs and DL-PCBs in gizzard shad, see bass and scabbard fish clearly have decreased, these are still heavily contaminated. As for the rest of these fishes, 7 species have increased and 2 species have decreased concentration levels. On the whole, levels of PCDD/DFs and DL-PCB in these fishes declined only a little. This implies that contamination levels in sea areas around Japanese Islands little changed during these 7 years.

Table 1. Levels of PCDD/Fs and DL-PCBs in individual common fishes in coastal & offshore fishes

	1999-2002		2003-2005		1999-2005	
	Number of Samples	average (pg WHO-TEQ/g fw)	Number of Samples	average (pg WHO-TEQ/g fw)	ranges (pg WHO-TEQ/g fw)	Standard Deviation
conger eel	3	4.46	14	4.62	1.14 - 12.58	3.00
sea bass	2	5.33	12	3.37	0.61 - 6.54	1.52
gizzard shad	2	5.22	13	2.67	0.73 - 9.15	2.47
scabbard fish	2	5.22	11	2.40	0.84 - 6.04	1.62
yellow tail	4	0.99	7	1.53	0.24 – 3.70	0.94
Pacific mackerel	5	0.83	13	1.58	0.24 – 6.04	1.33
sardine	6	1.44	6	0.88	0.08 - 2.34	0.77
red sea bream	2	0.33	3	1.04	0.13 - 2.05	0.67
jack mackerel	5	0.38	13	0.56	0.22 - 1.47	0.30
bonito	5	0.12	14	0.42	0.02 - 0.79	0.19
Pacific saury	5	0.35	14	0.21	0.13 - 2.25	0.19
dog salmon	8	0.11	8	0.12	0.08 - 0.17	0.03

Table 2 lists the results for some deep-sea & imported fishes examined individually. There is a serious problem of high level concentrations in bluefin tuna, especially from the Mediterranean Sea. The break down of bluefin tuna from the Mediterranean Sea is as follows; average level of PCDD/Fs and DL-PCBs in farmed bluefin tuna is 13.25pg WHO-TEQ/g fw (8 samples), and that of wild bluefin tuna is 5.17pg WHO-TEQ/g fw (5 samples). Bluefin tuna and southern bluefin tuna are indispensable material for Japanese sushi. Calculating levels of PCDD/Fs and DL-PCBs in sushi for one person, the total TEQ of the consumption will be more than 4 times higher than the Japanese TDI (4 pg WHO-TEQ/kg bw/day). These facts should also warn sushi consumers in Europe and the U.S.

Table 2. Levels of PCDD/Fs and DL-PCBs in some deep-sea & imported fishes

	1999 - 2002		2003 - 2005		1999 - 2005
	No. of Samples	average (pg WHO-TEQ/gfw)	No. of Samples	average (pg WHO-TEQ/gfw)	ranges (pg WHO-TEQ/gfw)
bluefin tuna (wild and farmed)	8	8.05	9	9.36	1.38 - 21.29
southern bluefin tuna (wild and farmed)	6	1.24	9	1.07	0.12 - 2.57
yellowfin tuna (wild)	7	0.03	19	0.05	0.00 - 0.39
silver salmon (farmed)	2	0.25	5	0.55	0.17 - 1.11
red salmon (wild and farmed)	1	0.26	5	0.27	0.22 - 0.29
Atlantic salmon (farmed)	2	3.00	4	1.72	1.30 - 3.13
mackerel (wild)	2	1.23	3	0.92	0.55 - 1.68

We have showed clearly that many coastal & offshore fishes are still contaminated considerably. In addition, some crustaceous and marine animals are also heavily contaminated which are not discussed here.

There is additional data regarding the dietary intake for PCDD/Fs and DL-PCBs from “Total Diet Study” carried out by The Ministry of Health, Labor and Welfare[4]. Between 1999 and 2005, the levels of the daily intake also have fallen steadily from 2.25 to 1.20 pg WHO-TEQ/kg bw/day. However, the average data are not sufficient to draw a conclusion. Taking account of the maximum intake within the range of the daily intake, it has decreased slightly but its value for 2005 remains 3.56 pg WHO-TEQ/kg bw/day. There may be a small number of people who eat an amount that is many times greater than the typical people do, and who likes to eat often the specific fishes such as tuna, sea bass and so on.

In 2003,we proposed in “The Dioxins Contaminations in Food” that Japanese TDI of 4 pg WHO-TEQ/kg bw/day which was fixed in 1999 should be revised at least 2 pg WHO-TEQ/kg bw/day as soon as possible. This proposal still stands. Furthermore, it is necessary to take measures by all means to establish appropriate Standard Level of PCDD/Fs and DL-PCBs in seafood, in order that overall consumers may eat the safe seafood for the benefits to health.

Acknowledgements

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