PCDDS, PCDFS, PCBS AND ORGANOCHLORINE INSECTICIDES IN HUMAN BREAST MILK COLLECTED FROM ASIAN DEVELOPING COUNTRIES: RISK ASSESSMENT FOR INFANTS

Tatsuya Kunisue[1], Mafumi Watanabe[1], Masayuki Someya[1], In Monirith[1], Tu Binh Minh[1], Annamalai Subramanian[2], Touch Seang Tana[3], Pham Hung Viet[4], Maricar Prudente[5] and Shinsuke Tanabe[1]

[1] Center for Marine Environmental Studies (CMES), Ehime University, Tarumi 3-5-7, Matsuyama 790-8566, Japan
[2] Center of Advanced Studies in Marine Biology, Annamalai University, Parangipettai 608502, Tamil Nadu, India
[3] Social and Culture Observation Unit (OBSES) of the Cabinet of the Council of Minister, Kingdom of Cambodia
[4] Center of Environmental Chemistry, Vietnam National University, 334 Nguyen Trai Str. Thanh Xuân Distr., Hanoi, Vietnam
[5] Science Education Department, De La Salle University, 2401 Taft Avenue, 1004 Manila, Philippines

Introduction

Polychlorinated dibenzo-*p*-dioxins (PCDDs), dibenzofurans (PCDFs), biphenyls (PCBs) and organochlorine insecticides are lipophilic stable contaminants, and have been of great concern regarding their toxic effects on humans and wildlife. In developed countries, it is suggested that residue levels of these contaminants in various environmental media and biota have generally decreased in recent decades (1, 2). In Asian developing countries, however, few studies have reported regarding exposure to these contaminants, especially dioxins and related compounds, for humans. In dumping sites of municipal wastes in Asian developing countries, secondary formation of dioxins and related compounds is anticipated, because a lot of various wastes has been dumped daily and continuously burned under low temperature by spontaneous combustion or intentional incineration. In addition, it is doubtful that organochlorine insecticides have been used there for public health purposes. These are suspected that many residents around these dumping sites are exposed to these contaminants. It is especially feared that *in utero* and lactational exposure to dioxins and related compounds may adversely affect brain development and immune systems of infants and children (3-6).

The present study attempted to elucidate the contamination status of PCDDs, PCDFs, PCBs and organochlorine insecticides in human breast milk collected from dumping sites of municipal wastes and reference sites in Asian developing countries, such as India, Cambodia, Vietnam and Philippines, and to assess the risk of exposure in their infants.

Materials and Methods

Human breast milk samples were collected from Perungudi, Chennnai in India on Aug. 2000, Meanchey, Phnom Penh in Cambodia on Nov. 1999 and Dec. 2000, Tay Mo, Hanoi in Vietnam on Apr. 2000 and Payatas, Quezon in Philippines on Feb. 2000, which have dumping sites of municipal wastes in the suburbs of urban area. In addition, samples were also collected from reference sites in India, Cambodia and Vietnam, where are located further away than 5 km from dumping sites. Breast milk samples were stored at –20 °C until analysis.

Chemicals analyzed in this study were PCDDs, PCDFs, PCBs, DDTs, HCHs, HCB, chlordane compounds (CHLs). Extraction was conducted using the method reported by Hirai *et al* (7). Cleanup and separation processes were followed by the method previously described (8, 9). Identification and quantification of PCDDs, PCDFs, non- and mono-*ortho* coplanar PCBs was performed using HRGC (Agilent 6890)-HRMS (JEOL JMS-700D and GCmate). Quantification of total PCBs, DDTs, HCHs, HCB, CHLs was performed using GC-ECD (Hewlett-Packard 6890). TEQs (toxic equivalencies) were calculated using WHO-TEFs (10).

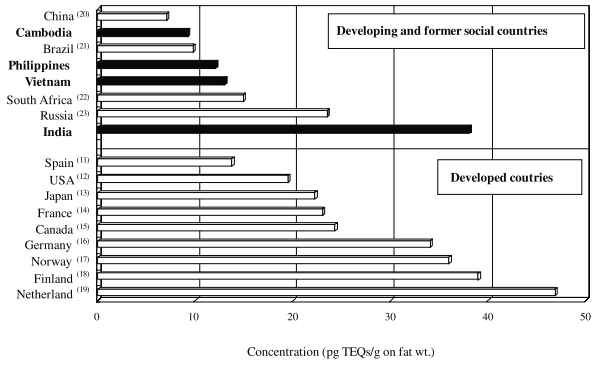
Results and Discussion

PCDDs, PCDFs, PCBs and organochlorine insecticides were detected in all the samples of human breast milk analyzed in this study (Table 1), indicating that the residents around dumping sites of

Table 1. Mean and range concentrations (pg/g or ng/g on fat wt#)of dioxins and related compounds, PCBs and organochlorine insecticides in human breast milk collected from residents around dumping sites of municipal wastes and reference sites in Asian developing countries

	India		Cambodia		Vietnam		Philippines
	dumping site	reference site	dumping site	reference site	dumping site	reference site	dumping site
	n =11	*n* =8	*n* =19	*n* =16	*n* =8	*n* =10	*n* =9
PCDDs	**290** (150-780)	**160** (70-240)	**49** (14-170)	**55** (20-150)	**32** (10-81)	**27** (14-41)	**190** (29-730)
PCDFs	**50** (15-130)	**18** (9.4-43)	**15** (5.2-55)	**11** (4.4-24)	**20** (7.3-42)	**20** (9.6-45)	**21** (5.9-44)
non-*ortho* PCBs	**260** (30-610)	**91** (42-340)	**51** (29-130)	**42** (19-79)	**62** (17-100)	**56** (29-100)	**76** (26-160)
mono-*ortho* PCBs	**38000** (2500-170000)	**6100** (2900-13000)	**8000** (820-28000)	**4900** (1300-12000)	**24000** (4200-46000)	**15000** (2800-22000)	**8800** (1700-28000)
TEQs	**38** (8.5-140)	**12** (7.0-17)	**9.2** (5.2-21)	**7.8** (1.9-15)	**13** (4.6-24)	**12** (6.5-19)	**12** (5.0-37)
PCBs	**110** (12-240)	**30** (9.2-69)	**56** (14-170)	**38** (11-130)	**170** (50-350)	**98** (54-210)	**72** (17-160)
DDTs	**420** (170-830)	**430** (160-1000)	**1200** (360-3800)	**1800** (310-11000)	**2800** (640-6900)	**1600** (480-3200)	**190** (35-570)
HCHs	**790** (100-2100)	**640** (300-1300)	**4.8** (1.5-18)	**5.6** (<0.21-21)	**74** (15-160)	**53** (25-79)	**4.7** (<0.56-10)
CHLs	**10** (0.51-38)	**0.91** (<0.14-3.8)	**1.7** (<0.26-5.0)	**1.6** (<0.21-5.3)	**1.6** (<0.20-3.8)	**1.9** (<0.22-1.8)	**15** (4.2-37)
HCB	**1.5** (<0.38-3.8)	**1.0** (<0.14-3.7)	**1.8** (0.59-8.1)	**1.6** (0.70-3.2)	**5.3** (1.4-9.5)	**3.5** (1.7-6.4)	**<0.56**

PCDDs, PCDFs, non- and mono-*ortho* PCBs and TEQs were represented with pg/g on fat wt. PCBs, DDTs, HCHs, CHLs and HCB were represented with ng/g on fat wt.



Reference data (11-23) were recalculated with WHO-TEFs (10).

Fig. 1 Comparisons of TEQs in human breast milk collected from dumping sites in Asian developing countries (India, Cambodia, Vietnam and Philippines) and those reported from other countries.

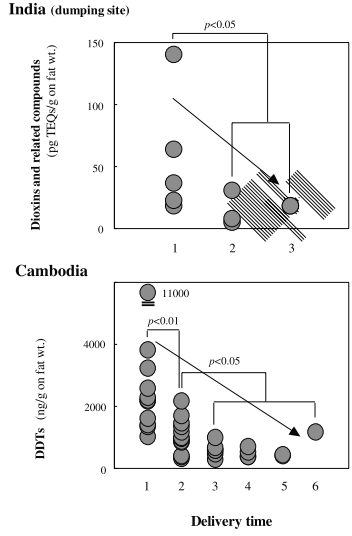


Fig. 2 Relationship between concentrations of TEQs and DDTs in human breast milk collected from India and Cambodia and the number of delivery times.

municipal wastes and reference sites in India, Cambodia, Vietnam and Philippines have been exposed to these contaminants. Concentrations of dioxins and related compounds in human breast milk from dumping sites in India were significantly higher than those from reference sites and other Asian developing countries ($p<0.05$) and the levels of TEQs were comparable to those (11-19) in general public of developed countries (Fig. 1). This indicates that significant pollution sources of dioxins and related compounds present in dumping sites in India and residents around there have been exposed to relatively high levels of these contaminants. On the other hands, TEQs in human breast milk from Cambodia, Vietnam and Philippines were relatively low and not significantly different between dumping sites and reference sites. The dominant organochlorine insecticides in human breast milk from India, Cambodia, Vietnam and Philippines were HCHs, DDTs, DDTs and DDTs, respectively, and not significantly different between dumping sites and reference sites. Especially, levels of HCHs in Indian and DDTs in Vietnamese and Cambodian were relatively high, indicating these contaminants have been used for public health purposes in these countries.

As examined the relationship between concentrations of TEQs and organochlorines in human breast milk and the number of delivery times, levels of these contaminants tended to decrease with increase of the number of delivery times (Fig. 2). Furthermore, estimated daily intakes (EDIs) of TEQs exceeded 4 pg TEQs/kg/day of TDI (WHO, 1998) for all the Asian developing countries, and EDIs of HCHs and DDTs exceeded 0.3 μg /kg/day of TDI (Health Canada, 1996) for all the Indian and 20μg / kg/day of TDI (WHO, 1982) for a few of Vietnamese and Cambodian, respectively. These results suggest that first infants have been exposed to higher levels of dioxins and related compounds and organochlorine insecticides from breast milk and might be at higher risk for these contaminants.

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