ORGANOHALOGENS IN WILDLIFE AND HUMAN IN TWO SPECIALIZED ENVIRONMENTS IN INDIA

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Introduction

The Center for Marine Environmental Studies (CMES), Ehime University, Japan has been carrying-out elaborate studies on the pollution status, sources and toxic implications of pollutants like organohalogen pesticides, industrial chemicals like PCBs, PBDEs and HBCDs and unintentional chemicals like dioxins and related chemicals (DRCs) in several Asian developing countries like India, Indonesia, Vietnam, Cambodia, Laos, etc. Among these countries, the CMES has started the survey in India in 1987 and continuing it till today. Our research efforts started in the coastal waters of southern India[1,2] and slowly moved inland[3] for survey locations. Later we started working on biotic samples[4,5]. From the early 2000s we have been working on wild life of India[6,7,8] and also human[9,10]. In many of the above surveys we found India as a source for global pollution of chemicals like HCHs, dioxins and heavy metals. Following this, as a result of our efforts on finding out the possible sources of these pollutants we found that the specialized environments like municipal solid waste dumping sites[11] and e-waste processing sites[12,13] were two of the prime locations for the release of some of these pollutants. The present paper explains our recent findings on the occurrence of some of the above stated organohalogens and their metabolites (hydoxylated and methylated PCBs and PBDEs) in wildlife and human in and around these two specialized environments in India.

Material and Methods

Specimens of crow, pig and human breast milk samples were collected from Chennai city (formerly Madras) and Kolkata city (formerly Calcutta) and the municipal solid waste dumping sites at the outskirts of these two cities in India. The reference samples were gathered from Chidambaram, a predominantly agricultural area that has no major waste dumping or processing site nearby. Human blood samples were gathered from the e-waste processing industry and backyard e-waste processing areas in Bangalore city. The reference samples of human blood were from Chennai city from people living far away from any e-waste processing area. Appropriate samples were analyzed for PCBs, dioxins, PBDEs and HBCDs and some of their metabolites (OH-PCBs, OH-PBDEs and MeO-PBDEs) using standard methodologies described in the publications cited above.

Salient Findings

We have been carrying-out elaborate studies in the municipal waste dumping and e-waste processing sites in India for more than last two decades. Some of our previous results from the environmental samples from the municipal solid waste dumping sites[14] and some data from the e-waste processing areas[15] were already published. Our efforts are still continuing and in this paper we will be discussing our results on the recent pollution status of some of the above chemicals in animal and human tissues collected from the above stated two specialized environments and reference sites in India.

The environment of municipal solid waste dumping sites of India were already reported in our studies as one of the prime sources of dioxins and related compounds[16] and some of these pollutants were also found to be accumulated in the bovine milk around the area[17]. Further, we found that the domestic animals living in and around and/or feeding on the refuse in these two sites have higher concentrations of certain chemicals released by the natural and human activities there. For example, the domestic pigs which are at loose in Chennai dumpsites are feeding all the edible refuse in and around the site. During that process they are profusely exposed to the contaminated edible items and soil in those sites.

We have analyzed the chlorinated dioxins, furans and dioxin like PCBs in their liver and found that many congeners were significantly higher in those from dumpsites than in the reference site samples (Fig. 1). The house crow muscle samples collected from the same area (dumping site for Chennai city) also had considerably higher levels of many of the congeners of dioxins, furans and dioxin like PCBs. This phenomenon has also been observed in the jungle crows from the same site when compared with crows gathered from Tokyo, Japan (data not shown) indicating that the municipal solid waste dumping site at the suburb of Chennai city acts as a source of some POPs chemicals. This may probably true for all the more than 250 licensed and several thousands of unlicensed dumpsites in India, because almost similar situations occur at all of them (unsegregated dumping, intentional burning, etc.).

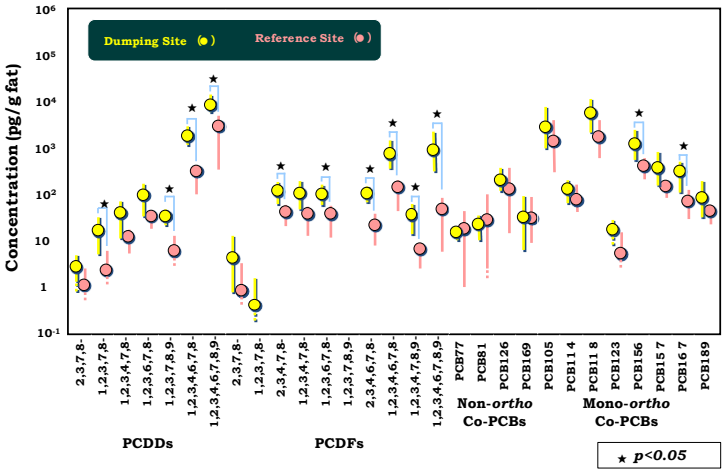

Fig. 1. Comparison of hepatic DRCs concentrations between male pigs from dumping and reference

Further to this, we have also noticed statistically higher levels of organochlorines like PCBs, CHLs, etc. in the municipal solid waste dumpsites of Kolkata city in the northeastern state West Bengal State of India. Even though dioxins and furans were not statistically higher in the dumpsite samples, total TEQs and dioxin like PCBs were greater than in the control site (data not shown). Yet another survey in the India showed that the PCBs and novel POP chemical PBDEs in the human milk samples were higher in the samples from the mothers living in and around the dumpsite (near Chennai city) than in urban, semiurban, urban slum and fishing areas of India (Fig. 2).

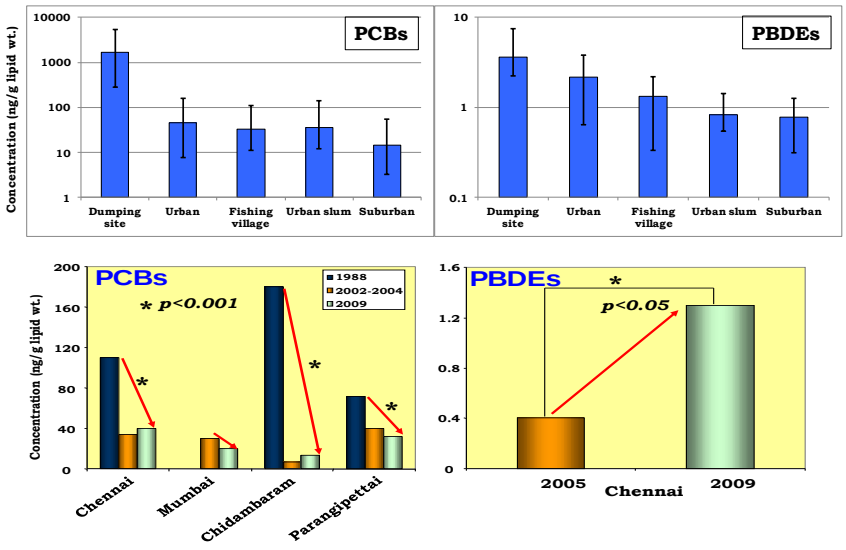

Fig. 2. PCBs and PBDEs in the human milk samples from India

Recently we have surveyed several POP chemicals in the human blood samples obtained from an e-waste recycling factory at Bangalore, India and we found that PCBs and PBDEs that were normally released during such processing were not considerably higher in the blood samples obtained from the e-waste processing factory than in the samples collected from a rural area (Chidambaram). At the same time, the metabolites of these compounds (OH-PCBs, OH-PBDEs and MeO-PBDEs) were statistically higher in the samples from the processing factory (Fig. 3). We could also see a linear relationship between the levels of the parent PCBs and OH-PCBs, whereas no such relationship was found between PBDEs and its metabolites (data not shown) suggesting that OH-PCBs in the blood of human are the products of PCBs that were metabolized in human body and/or taken from the environment along with the parent compounds whereas OH-PBDEs might have originated from different source(s). One of our recent works shows that the backyard (unlicensed) e-waste processing areas in the city is a major source of heavy metal pollution and the contamination levels there were higher than in the licensed e-waste processing factory (Ha et al., 2009) and also it can be expected that those areas may also be the sources for higher levels of classic and emerging POPs chemicals, than in the organized sector e-waste processing.

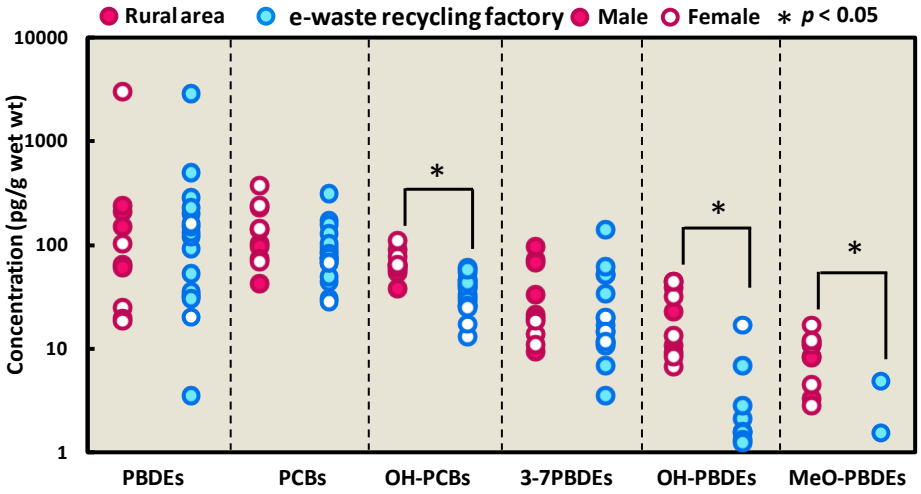

Fig. 3. Concentrations of contaminants in human serum from e-waste processing factory workers and rural area in India

Conclusion

The three decades long surveys of the Center for Marine Environmental Studies (CMES), Ehime University shows India as one of the prime sources of many persistent pollutants distributed via transportation through atmosphere, water, soil and sediments. Our recent works in that country shows that the prime two areas of pollution by such chemicals are the municipal solid waste dumpsites at the periphery of the major cities and also the e-waste processing factories and backyard processing areas. Apart from the elevated levels found in the environmental samples such as air, water, soil and sediments, in our recent surveys we found that the liver of domestic pigs and muscle of house and jungle crows foraging in the solid waste dumpsites had elevated levels of dioxins and dioxin like PCBs than their counterparts in non-contaminated areas. Likewise, we found higher levels of some of the metabolite compounds (OH-PCBs, OH-PBDEs and MeO-PBDEs) in the human blood samples from the e-waste processing factory than in the samples from the reference sites. Ironically the levels of the parent compounds (PCBs and PBDEs) in the blood of the factory workers were not higher than their counterparts from the non-e-waste sites.

Acknowledgements
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