

The past, present, and future research topics with CALUX assays in Japan

Contents

- Past research topics
- Ongoing research topic
“Indoor dust study”
- Near future topic



Go Suzuki and Hidetaka Takigami

National Institute for Environmental Studies
Japan

Past research topics

Past research topics with CALUX assays in Japan

Toxicity Reduction Evaluation (TRE) study with DR-CALUX

- Dechlorination process for incineration ash
- Remediation of soils contaminated by PCB oil
- Various destruction process for PCB oil

Toxicity Identification Evaluation (TIE) study with DR-CALUX

- Organic waste compost
- Surface and core from harbor city of Osaka in Japan

Past research topics with CALUX assays in Japan

Toxicity Identification Evaluation (TIE) study with DR-CALUX

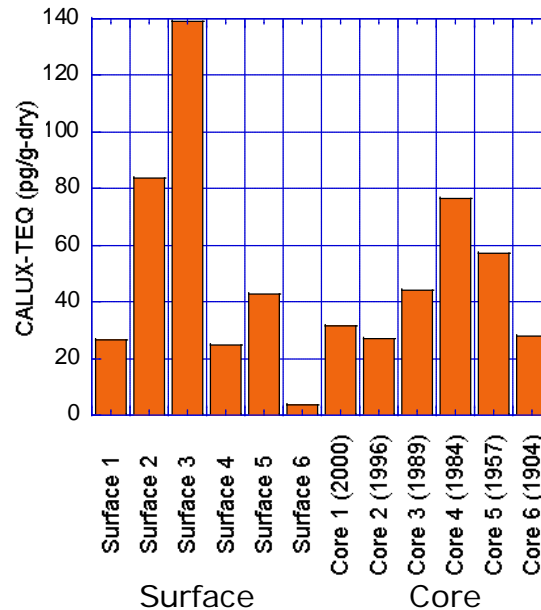
- Surface and core sediment from harbor city of Osaka in Japan



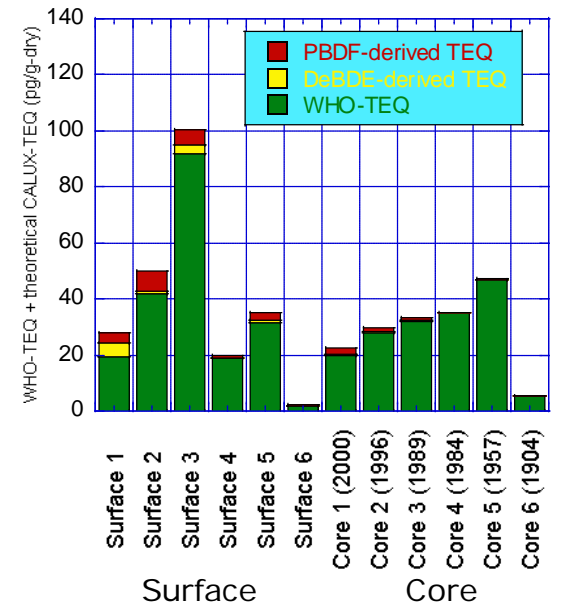
Surface sediment samples

CALUX-TEQ (left) and calculated TEQ values (right)
in surface and core sediments from Osaka Bay

CALUX analysis (experimental)



WHO-TEQ
+ theo. CALUX-TEQ (PBDF+PBDE)



Ongoing research topics

Ongoing research topics with CALUX assays in Japan

Toxicity Identification Evaluation (TIE) study with various CALUXs

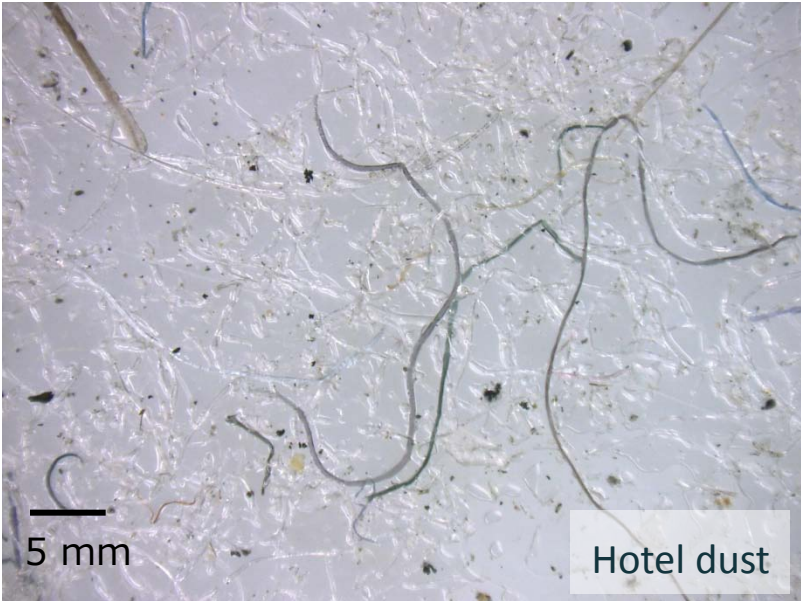
- Indoor dust as an important exposure pathway for children
- High-trophic level animal tissue containing bioaccumulated compounds
- Environmental impact of E-waste crude recycling
- Safety recycle and use of biodiesel from cooking oil waste
- Environmental impact of effluent from sewage-treatment plant in Japan and US

Indoor dust study



1 cm

Indoor dust

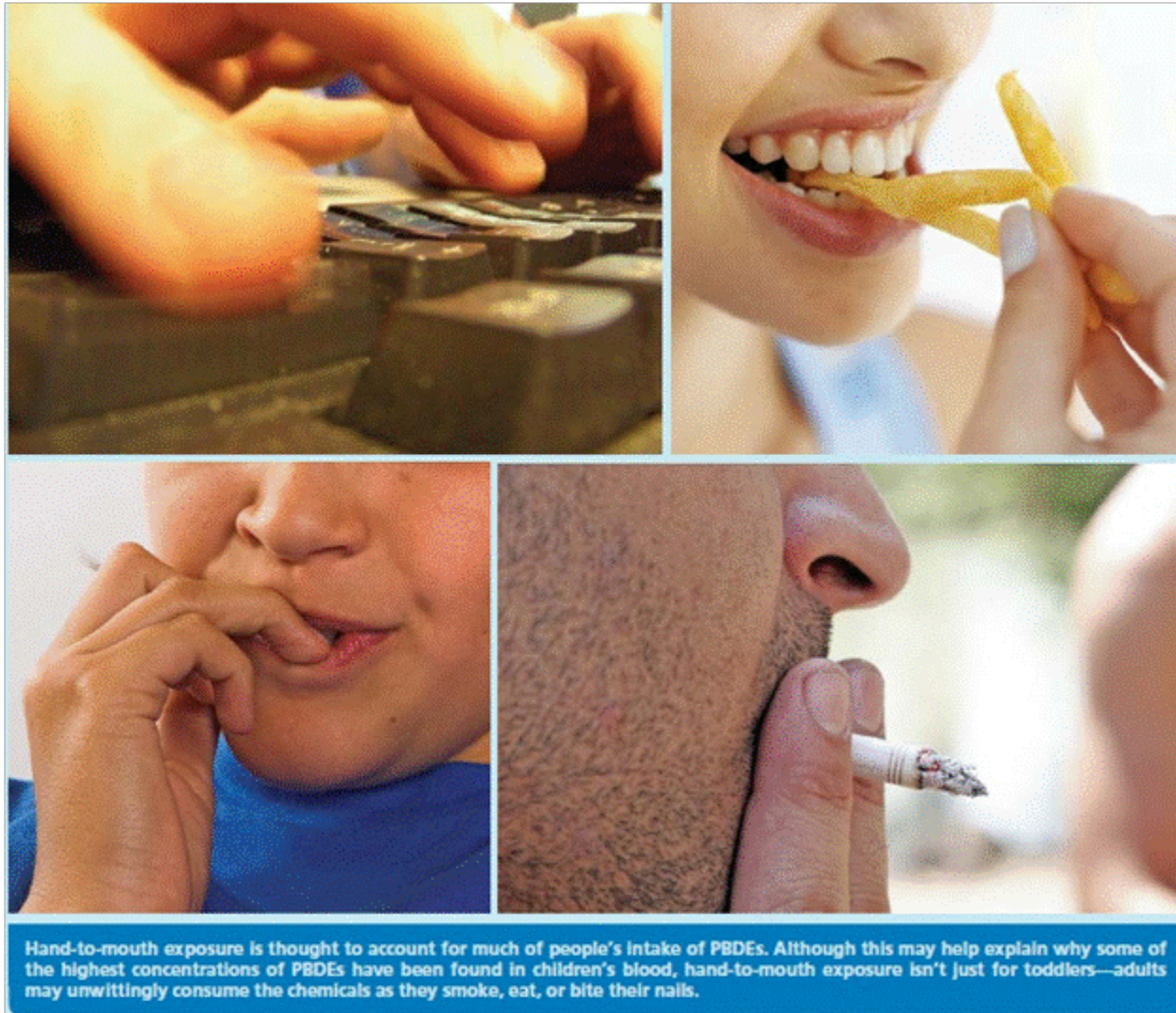


Concern about flame retardants (FRs) in indoor dust



PBDEs are used in a number of consumer goods, including video and computer equipment, cell phones, mattresses, upholstered furniture, carpet padding, and automobile electronics and seats. Virtually all samples tested for PBDEs in the National Health and Nutrition Examination Survey contained BDE-47.

Concern about flame retardants (FRs) in indoor dust



Polybrominated diphenylether (PBDEs) as FRs in indoor dust

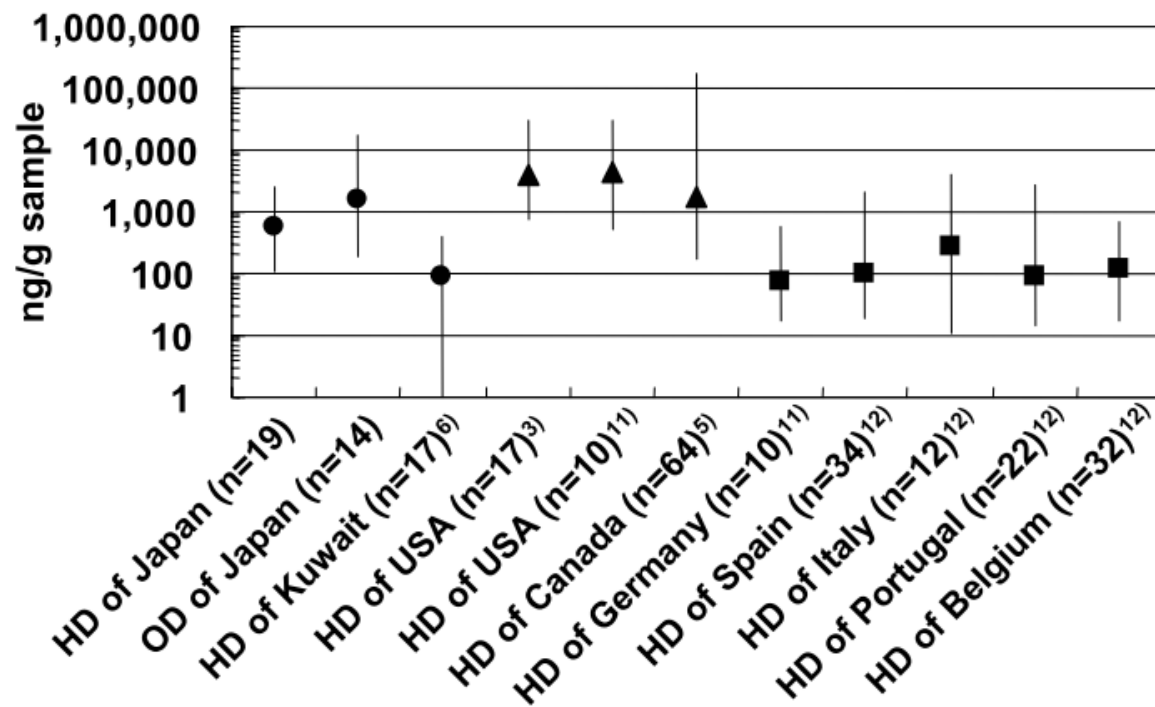


Fig. 2. Comparison of PBDE levels to the previous studies

Proof of existence of PBDEs in indoor dust

Existence State of Bromine as an Indicator of the Source of Brominated Flame Retardants in Indoor Dust

GO SUZUKI,^{*,†,‡} AKIKO KIDA,[†]
SHIN-ICHI SAKAI,[§] AND
HIDETAKA TAKIGAMI[†]

*Research Center for Material Cycles and Waste Management,
National Institute for Environmental Studies, Tsukuba,
305-8506, Japan, Center for Marine Environmental Studies,
Ehime University, Matsuyama 790-8577, Japan, and
Environment Preservation Center,
Kyoto University, Kyoto 606-8501, Japan*

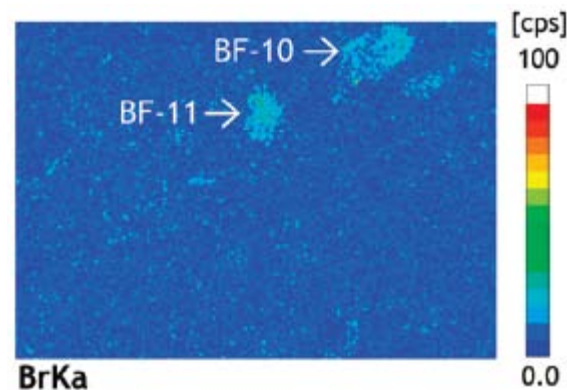
*Received September 12, 2008. Revised manuscript received
December 11, 2008. Accepted December 14, 2008.*

f. Private company



10.0 x 7.5mm

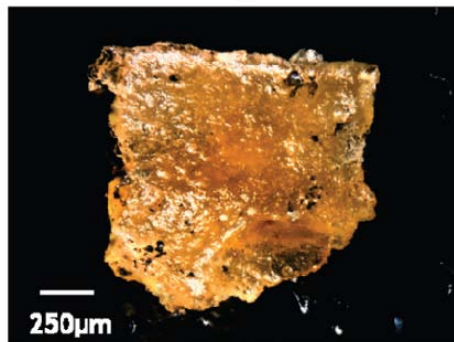
Image of tested samples



XRFS image of Br-mapping

Proof of existence of PBDEs in indoor dust

Bromine-rich fragment 2



Bromine-rich fragment-10

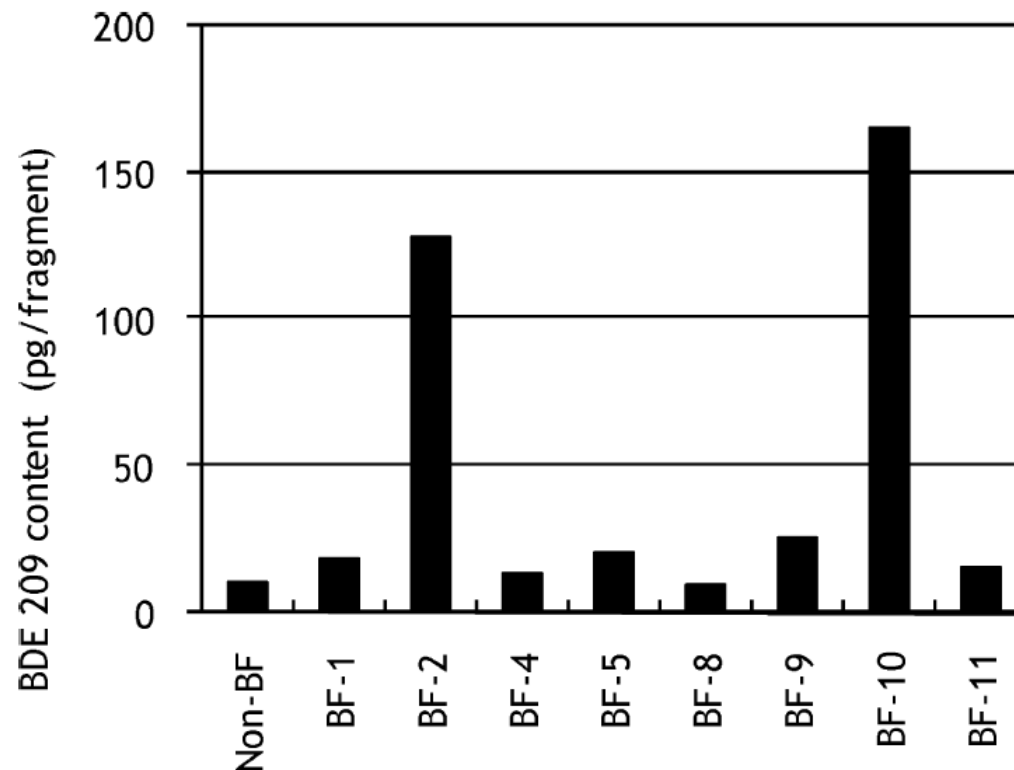
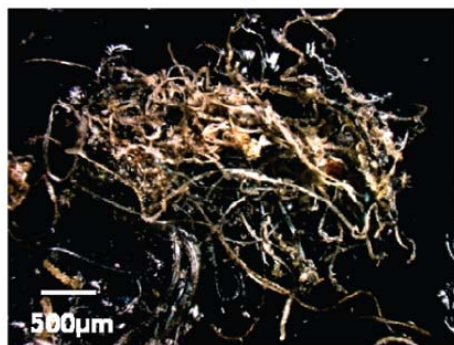
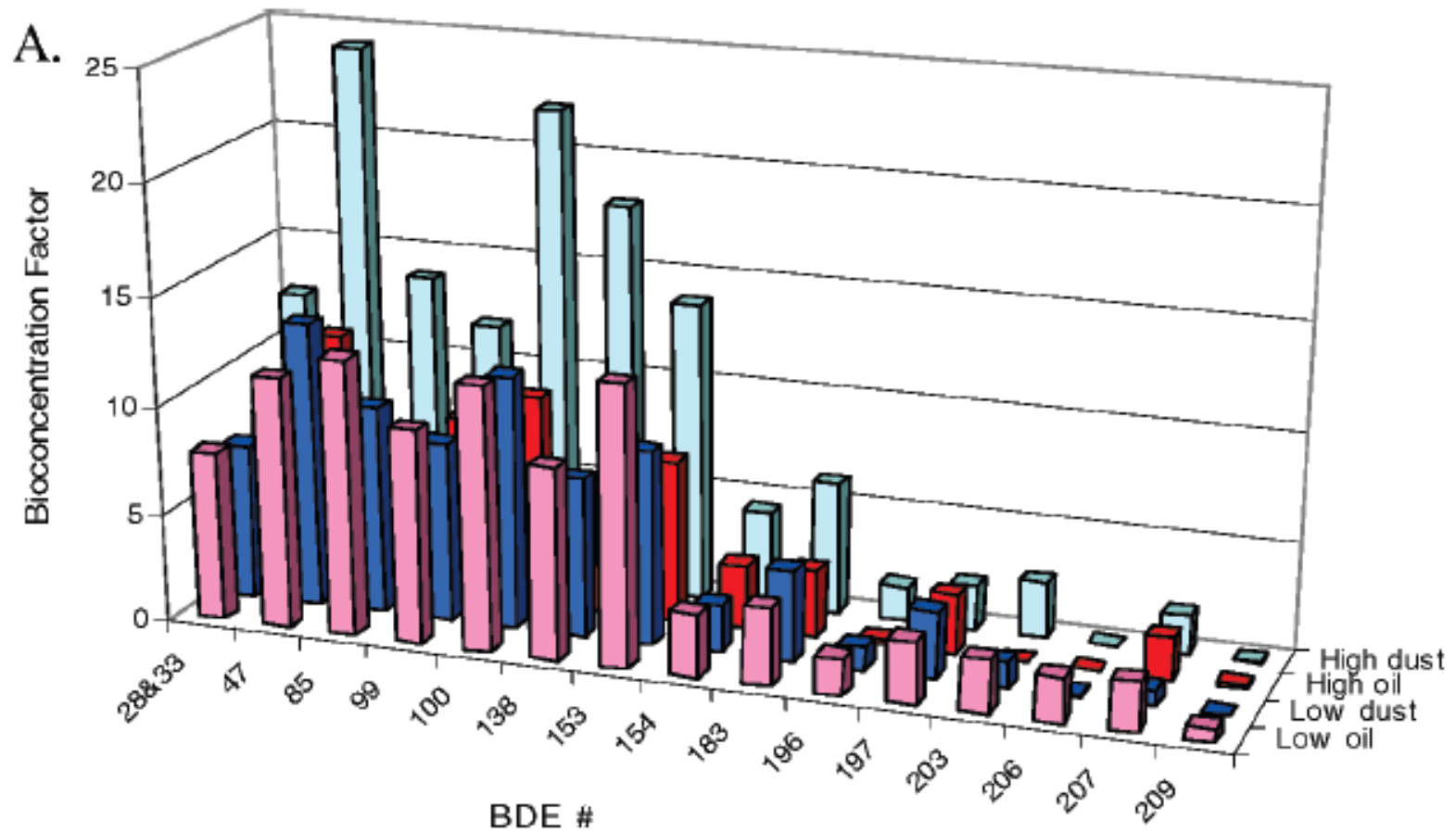


FIGURE 3. BDE 209 content in bromine-rich fragments: non-BF = non-bromine-containing fragment; BF = bromine-rich fragment.

Bioavailability of PBDEs in indoor dust

Epididymal fat tissue



TIE with DR-CALUX assay

Dioxin-like compounds in indoor dust

Dioxin-Like and Transthyretin-Binding Compounds in Indoor Dusts Collected from Japan: Average Daily Dose and Possible Implications for Children

GO SUZUKI,^{*,†} HIDETAKA TAKIGAMI,[†]
KAZUTOSHI NOSE,[†] SHIN TAKAHASHI,[‡]
MISUZU ASARI,[§] AND SHIN-ICHI SAKAI[§]

*Research Center for Material Cycles and Waste Management,
National Institute for Environmental Studies,
Tsukuba, 305-8506, Japan, Center for Marine Environmental
Studies, Ehime University, Matsuyama 790-8577, Japan, and
Environment Preservation Center, Kyoto University,
Kyoto 606-8501, Japan*

Concept of Toxic Equivalency Factors (TEF)

Toxic Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs for Humans and Wildlife

Martin Van den Berg,¹ Linda Birnbaum,² Albertus T.C. Bosveld,³ Björn Brunström,⁴ Philip Cook,⁵ Mark Feeley,⁶ John P. Giesy,⁷ Annika Hanberg,⁸ Ryuichi Hasegawa,⁹ Sean W. Kennedy,¹⁰ Timothy Kubiak,¹¹ John Christian Larsen,¹² F.X. Rolaf van Leeuwen,¹³ A.K. Djien Liem,¹⁴ Cynthia Nolt,¹⁵ Richard E. Peterson,¹⁶ Lorenz Poellinger,¹⁷ Stephen Safe,¹⁸ Dieter Schrenk,¹⁹ Donald Tillitt,²⁰ Mats Tysklind,²¹ Maged Younes,²² Fredrik Wærn,⁸ and Tim Zacharewski²³

The criteria for including a compound in a fish and wildlife TEF scheme are the same criteria as those used for the derivation human TEFs (1). These are 1) a compound must show a structural relationship to the PCDDs and PCDFs; 2) a compound must bind to the Ah receptor; 3) a compound must elicit Ah receptor-mediated biochemical and toxic responses; and 4) a compound must be persistent and accumulate in the food chain.

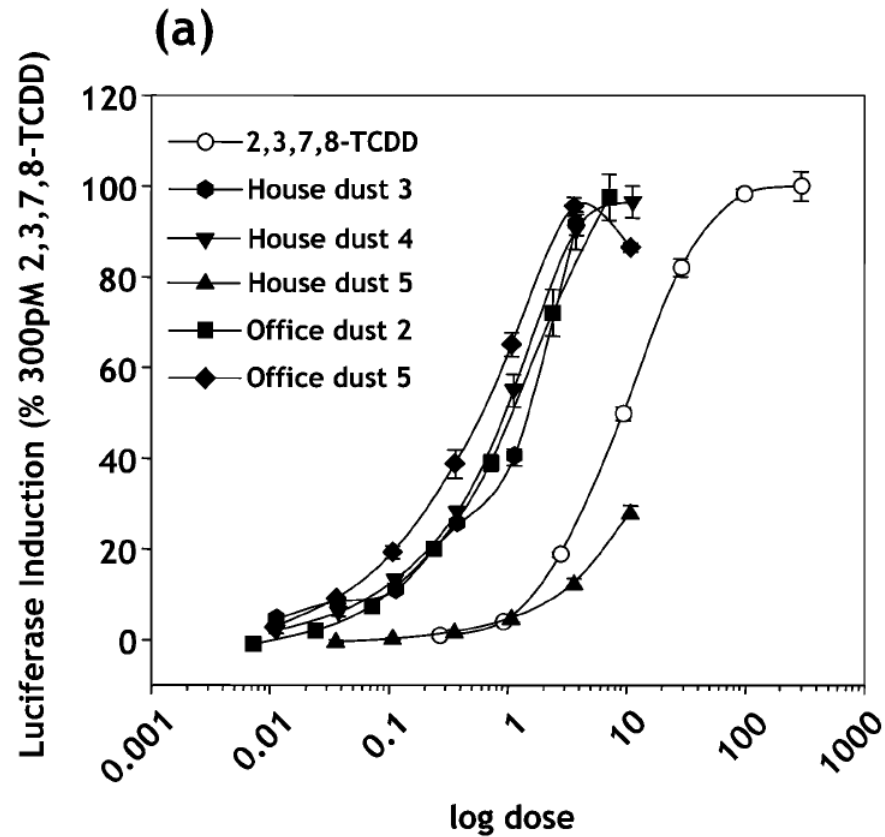
For criteria 1) and 4)

- Toluene-Sohxlet extraction
- Sulfuric-acid and acid silicagel column treatment

For criteria 2) and 3)

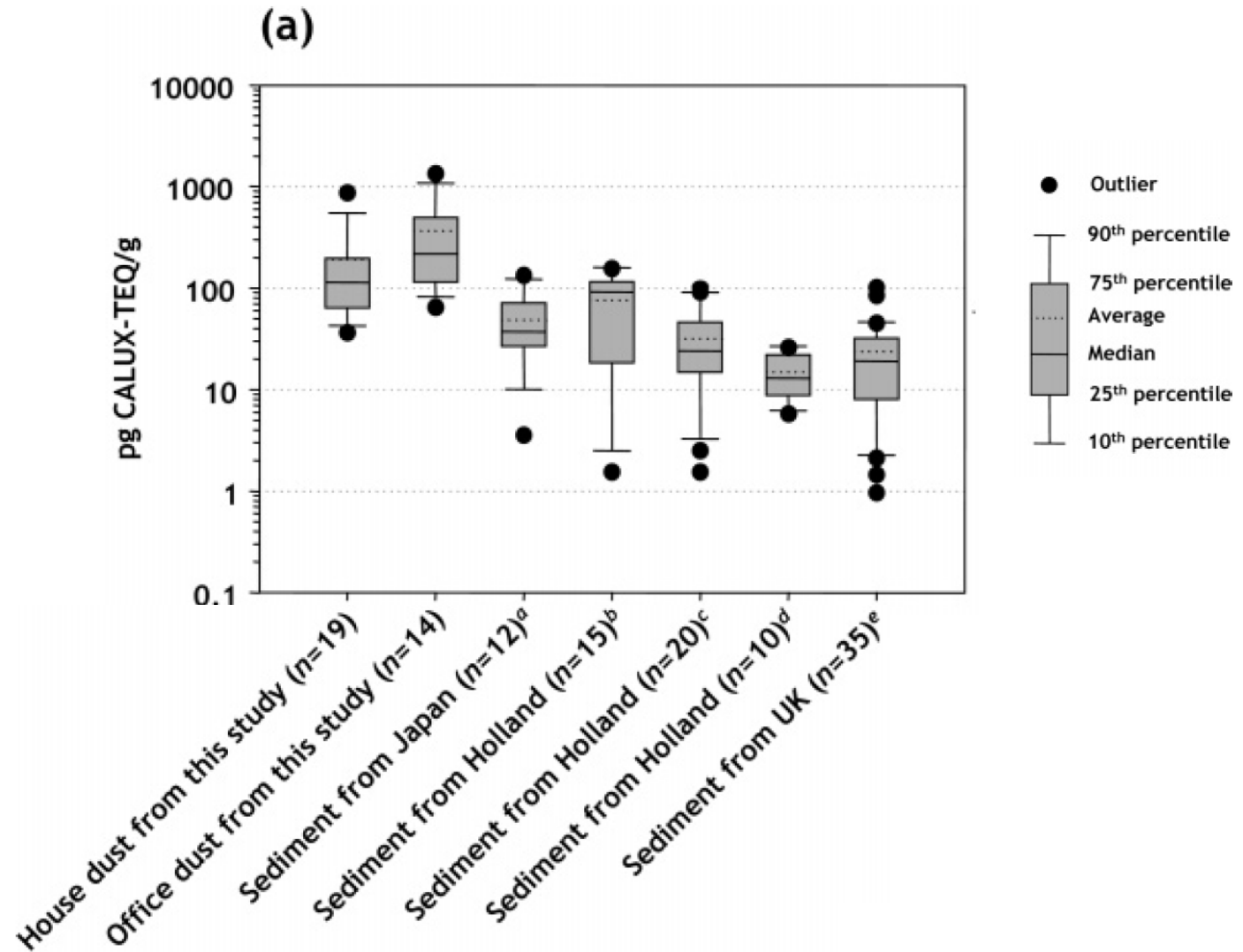
- DR-CALUX assay

Dose-response of indoor dust extracts on DR-CALUX cells



pM 2,3,7,8-TCDD in well
mg dust in well

CALUX-TCDD equivalent for indoor dust extract



Dioxin-like Activity in Japanese Indoor Dusts Evaluated by Means of *in Vitro* Bioassay and Instrumental Analysis: Brominated Dibenzofurans Are an Important Contributor

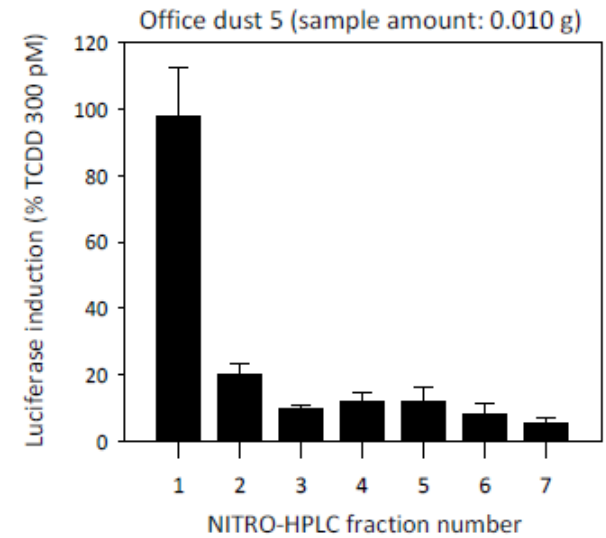
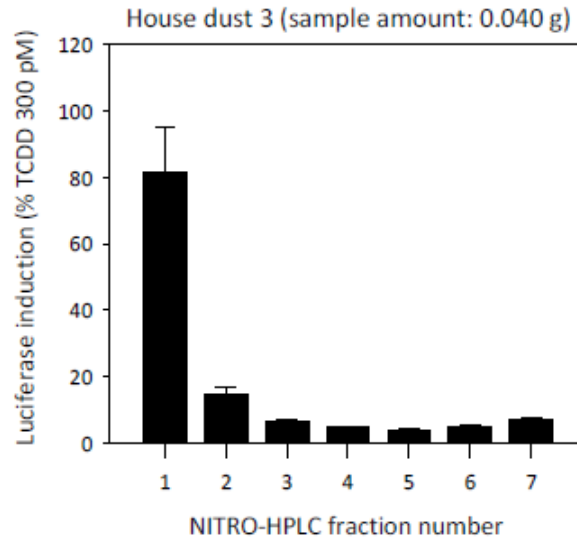
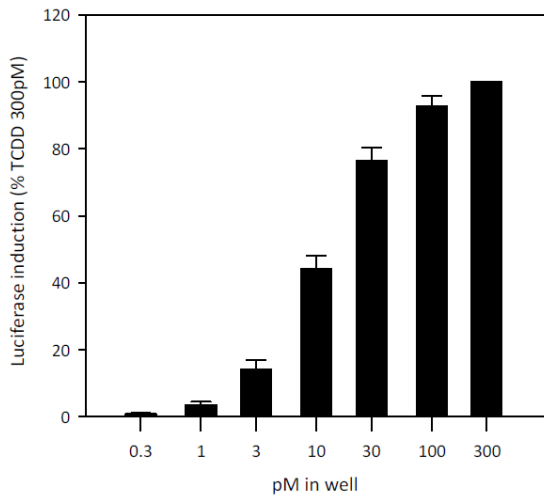
GO SUZUKI,^{*,†,‡} MASAYUKI SOMEYA,[‡]
SHIN TAKAHASHI,[‡] SHINSUKE TANABE,[‡]
SHIN-ICHI SAKAI,[§] AND
HIDETAKA TAKIGAMI[†]

*Research Center for Material Cycles and Waste Management,
National Institute for Environmental Studies,
Tsukuba 305-8506, Japan, Center for Marine Environmental
Studies, Ehime University, Matsuyama 790-8577, Japan, and
Environment Preservation Center, Kyoto University,
Kyoto 606-8501, Japan*

*Received June 15, 2010. Revised manuscript received
September 10, 2010. Accepted September 12, 2010.*

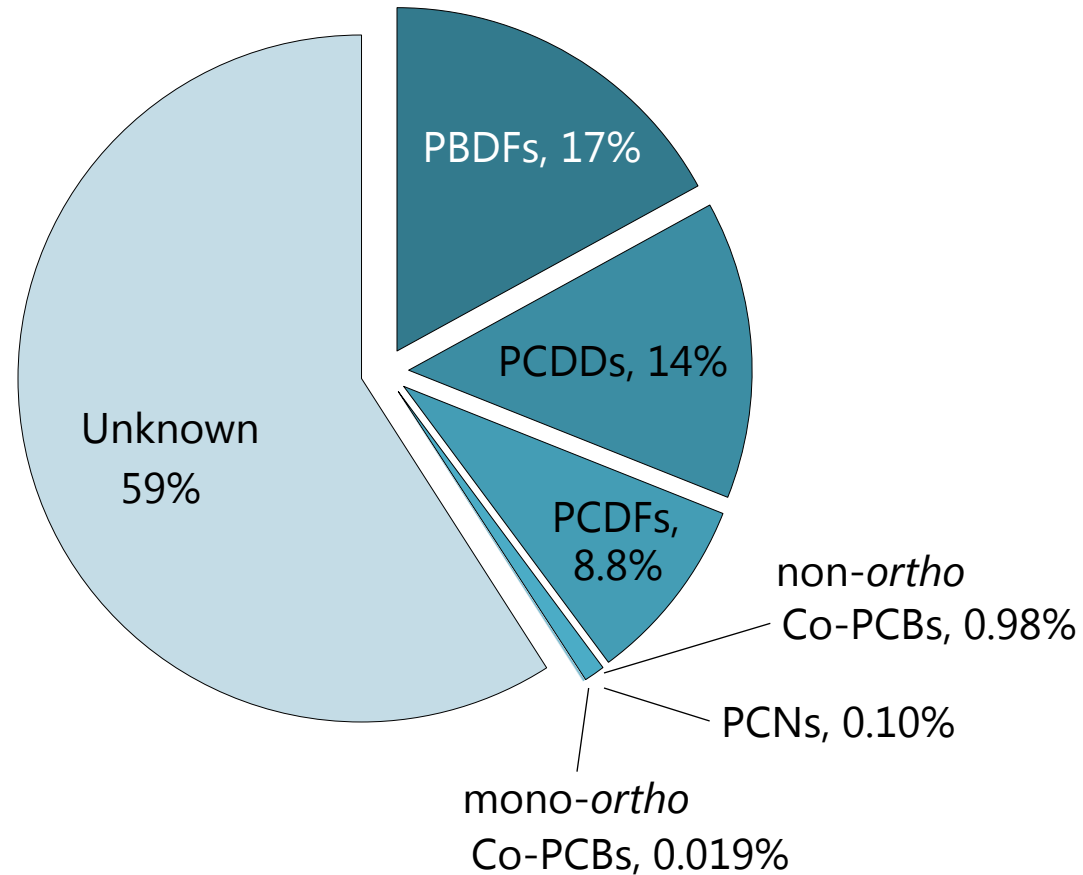
NITRO-HPLC fractionation with DR-CALUX

The 1st fraction containing compounds with 2~3 rings indicates higher activity



Brominated dibenzofurans are an important contributor

Median-based contribution ratio for dioxin-like compounds in indoor dust ($n=33$)



TEFs for brominated dibenzofurans

Day / Time: Wednesday, Mar. 14, 1:00 PM - 4:30 PM

Program Number: 2506 Board # 552

The use of toxic equivalency factors (TEFs) for polybrominated dibenzodioxins (PBDDs) and dibenzofurans (PBDFs) in risk assessment

M.Van den Berg^{1,5}; H.Fiedler²; A.M.Tritscher³; R.E.Peterson⁴. 1. Institute for Risk Assessment Sciences, Utrecht University, Utrecht, Netherlands; 2. World Health Organization (WHO), Geneva, Switzerland; 3. United Nations Environmental Program (UNEP), Geneva, Switzerland; 4. University of Wisconsin-Madison, Madison, WI; 5. WHO Collaborating Centre for Research on Environmental Health Risk Assessment, Utrecht, Netherlands.

- TriBDD in food materials
- PBDFs in indoor dusts

Ongoing research for indoor dust

***In Vitro* Toxicological Similarities between Flame Retardants and Indoor Dust Collected from Japan, US, Vietnam, the Philippines, and Indonesia**

Suzuki G^{1*}, Tue NM², Takahashi S², Tanabe S², Sakai S³, Malarvannan G², Sudaryanto A², Brouwer A⁴, Uramaru N⁵, Kitamura S⁵, Takigami H¹

¹National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba 305-8506, Japan; ²Ehime University, Matsuyama 790-8577, Japan; ³Kyoto University, Kyoto 606-8501, Japan; ⁴BioDetection Systems b.v., 1098 XH Amsterdam, the Netherlands; ⁵Nihon Pharmaceutical University, Kita-adachi 362-0806, Japan

- Indoor dusts collected from various countries
- Acetone extract + Toluene extract
- Crude extract without sulfuric acid and acid silicagel column treatment
- CALUX assays such as AR, ER α , PR, GR, TR β and PPAR γ 2

→ Identification study for subsequent *in vivo* study and detailed monitoring

Future research for indoor dust



[MOE](#) » [Health & Chemicals](#) » [JECS](#)

The Japan Environment and Children's Study (JECS), a birth cohort study involving 100,000 parent-child pairs, was launched in 2011 in order to evaluate the impact of various environmental factors on children's health and development. The concept plan of JECS was published in March 2010 after three years of development within expert groups and public discussions about the research hypotheses and aims. Pilot studies started in 2008 in four universities, and samples from two preceding cohorts (Hokkaido and Tohoku) are also used for establishing exposure measurement protocols. Recruitment of participating pregnant women started in January 2011, and will continue until 2013. Health outcomes and exposure measurements will continue until the participating children become 13 years old.

Future research for indoor dust



- Ongoing research for indoor dust by using TIE with CALUX assays will be conducted as JECS pilot study.

Acknowledgement



National Institute for Environmental Studies



Center for Marine Environmental Studies, Ehime University



BioDetection Systems b.v.



Environment Preservation Research Center, Kyoto University

Funding



Japan Society for the Promotion of Science

- Young Scientists A (no. 23681011)
- Scientific Research S (no. 20221003)
- Scientific Research B (no. 24360377)



Ministry of the Environment, Japan

- Extend 2010