Midterm Workshop of the UN Environment/GEF project ‘Continuing Regional Support for the POPs Global Monitoring Plan under the Stockholm Convention’ in the Asia Region
Ulaanbaatar, Mongolia, 8-10 August 2018

2016-2019 round of UNEP-coordinated exposure studies on human milk in the Asia region

Rainer Malisch
CVUA Freiburg, Germany
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- State Institute for Chemical and Veterinary Analysis of Food
- WHO / UNEP Reference Laboratory
- EU Reference Laboratory (EURL) for Halogenated POPs in Feed and Food
- EURL for Pesticides in Food of Animal Origin
WHO/UNEP-coordinated exposure studies on levels of POPs in human milk

<table>
<thead>
<tr>
<th>Round</th>
<th>Years</th>
<th>Organized by</th>
<th>No of countries</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1987-1988</td>
<td>WHO-EURO</td>
<td>12</td>
<td>Dioxins and PCBs</td>
</tr>
<tr>
<td>2</td>
<td>1992-1993</td>
<td>WHO-EURO</td>
<td>19</td>
<td>Dioxins and PCBs</td>
</tr>
<tr>
<td>3</td>
<td>2000-2003</td>
<td>WHO-EURO</td>
<td>26</td>
<td>Dioxins and PCBs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>later Stockholm Convention Initial POPs</td>
</tr>
<tr>
<td>5</td>
<td>2008-2011</td>
<td>WHO/UNEP</td>
<td>45</td>
<td>Stockholm Convention POPs</td>
</tr>
<tr>
<td>6</td>
<td>2012-2015</td>
<td>UNEP</td>
<td>17</td>
<td>Stockholm Convention POPs</td>
</tr>
<tr>
<td>7</td>
<td>since 2016</td>
<td>UNEP</td>
<td>42</td>
<td>Stockholm Convention POPs</td>
</tr>
</tbody>
</table>
## Participants 2000 - 2015

<table>
<thead>
<tr>
<th>Africa</th>
<th>America</th>
<th>Asia</th>
<th>Australia, NZ, Pacific Islands</th>
<th>Europe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congo (DR) x</td>
<td>Antigua-Barb. x</td>
<td>Hong Kong SAR x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Côte d'Ivoire x x</td>
<td>Barbados x</td>
<td>India x</td>
<td>x</td>
<td>Fiji x</td>
</tr>
<tr>
<td>Djibouti x</td>
<td>Brazil x</td>
<td>Indonesia x</td>
<td>x</td>
<td>Kiribati x</td>
</tr>
<tr>
<td>Egypt x</td>
<td>Chile 2 x</td>
<td>Israel x</td>
<td>Marshall Islands x</td>
<td>x</td>
</tr>
<tr>
<td>Ethiopia x x</td>
<td>Cuba x</td>
<td>Korea (Rep) x</td>
<td>x</td>
<td>New Zealand x</td>
</tr>
<tr>
<td>Ghana x</td>
<td>Haiti x x x</td>
<td>Philippines x</td>
<td>Niue x</td>
<td>x</td>
</tr>
<tr>
<td>Kenya x</td>
<td>Jamaica x</td>
<td>Syria x</td>
<td>Palau x</td>
<td>x</td>
</tr>
<tr>
<td>Mali x</td>
<td>Mexico x</td>
<td>Tajikistan x</td>
<td>Samoa x</td>
<td>x</td>
</tr>
<tr>
<td>Mauritius x</td>
<td>Peru x</td>
<td>total no: 8</td>
<td>Solomon Islands x</td>
<td>x</td>
</tr>
<tr>
<td>Niger x x</td>
<td>Suriname x</td>
<td>Tonga x</td>
<td>Ireland x</td>
<td>x</td>
</tr>
<tr>
<td>Nigeria x</td>
<td>Uruguay x</td>
<td></td>
<td>Tuvalu x</td>
<td>Italy x</td>
</tr>
<tr>
<td>Senegal x</td>
<td>USA x</td>
<td>total no: 12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sudan x</td>
<td>total no: 15</td>
<td></td>
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<tr>
<td>Togo x</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Uganda x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**total number of countries:** 69

- once 43
- twice 21
- three times 4
- four times 1

**resulting number of country/year-data:** 101

**total number of pooled samples:** 188
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
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<td></td>
</tr>
<tr>
<td>Hong Kong SAR</td>
<td>x</td>
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<tr>
<td>Cambodia</td>
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<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>India</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Indonesia</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td>(x)</td>
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<tr>
<td>Israel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
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<tr>
<td>Korea (Rep)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Lao PDR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Mongolia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Philippines</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Syria</td>
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<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Tajikistan</td>
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<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Thailand</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Vietnam</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

*total no: 13 (2016-2019:6)*
Key aspects for human milk monitoring

- Effectiveness evaluation (time trends)
- Inclusion of new POPs
- Cost-effective approach to evaluate relevance of individual POPs
- Support of capacity building (quality control in labs)
Human tissues as indicators of human exposure to POPs

Human samples as suitable indicators for bioaccumulation of POPs:

- Breast milk
- Blood
- Adipose tissues

Comparable results on fat basis
Advantage of breast milk samples

- non-invasive mean to estimate the exposure
- Less toxicological concern (relatively high risk of contacts with infectious agents: AIDS virus, hepatitis) than for human blood
- human milk has higher fat content than blood

- For analysis: available amount of lipids important factor with regard to number of analytically covered POPs and LOQs
  - Lipid amount of type of sample
  - Mixing (pooling)
Standardized protocol

- **Collection of human milk from** representative individuals *(since 2007: n = 50)*

- **Preparation of one** pooled (=mixed) sample *representative* for a country / region

- Analysis by Reference Laboratory for reliable and comparable data

(+) **Cost-effective** and useful non-invasive mean to estimate the overall exposure of a local population

- Possible to get a rough estimate on the exposure in different regions of the world and time trends with only very few samples
Standardized protocol

- **Collection of human milk from representative individuals** (*since 2007: n = 50*)
- **Preparation of one pooled (=mixed) sample representative for a country / region**
- **Some flexibility:**
  - Countries with populations greater than 50 million should include at least one additional participant per one million population over 50 million. Countries with populations well over 50 million (or with sufficient resources) are encouraged to prepare a second pooled sample (or more) if feasible.
  - Small countries: less?

Brazil 210,000,000

e.g. Fiji 880,000; Tuvalu 10,000
Sample preparation scheme: Preparation of individual samples for analysis of basic POPs by country and of pooled (mixed) samples

(Before taking an aliquot, shake intensely at room temperature and then take the aliquot immediately. Storage and shipment of all samples deep-frozen.)

- take 25 ml into 2000 ml bottle (50 * 25 ml ea = 1250 ml)
- Send the 2000 ml bottle with frozen pooled samples to WHO/UNEP Reference Lab
- Individual samples for analysis by country for basic POPs
  For (deep-frozen) storage in and analysis by country. If no analysis in country possible and no storage capacity available, contact UNEP.

Mean of individual samples should be comparable to concentration found by reference lab.
UNEPA-coordinated Survey of Human Milk for Persistent Organic Pollutants

Guidelines for Organization, Sampling and Analysis

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for:

Chemicals Branch
Division of Technology, Industry and Economics (DTIE)
United Nations Environment Programme (UNEP)
Video on guidelines

https://youtu.be/7LwJ0x2_PWQ

Preparing the video:
Alejandra Torre
Gabriela Medina
Virginia Santana

Brief introduction to the Guidelines for Organization, Sampling and Analysis

UNEP-coordinated Survey of HUMAN MILK for Persistent Organic Pollutants
Project Cooperation Agreement (PCA),
part I: shipment of glassware containers (60 x 100 ml; 1 x 2000 ml)

(here: 7 countries from Asia)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Comments for 2016</th>
<th>Comments for 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply of samplers for human milk for 9 countries of Pacific Islands</td>
<td>Purchase and cleaning of glassware for 9 countries, shipment to 8 countries</td>
<td>Shipment to 1 country; with 1 country (Fiji) not accepting the first shipment; therefore a second shipment necessary</td>
</tr>
<tr>
<td>Supply of samplers for human milk for 7 countries of Asia-Pacific</td>
<td>7 Purchase and cleaning of glassware for 7 countries, no shipment in 2016</td>
<td>7 Shipment to 7 countries, with 1 country (Philippines) not accepting the first shipment; therefore a second shipment necessary</td>
</tr>
<tr>
<td>Supply of samplers for human milk for 15 countries in Africa</td>
<td>5 Purchase and cleaning of glassware for 15 countries, shipment to 13 countries</td>
<td>Shipment to 2 countries</td>
</tr>
<tr>
<td>Supply of samplers for human milk for 12 countries of GRULAC</td>
<td>12 Purchase and cleaning of glassware for 12 countries, no shipment in 2016 (one country not selected, so far)</td>
<td>12 Shipment to 11 countries (1 country not responding)</td>
</tr>
</tbody>
</table>

- Finally, 6 countries received glassware
- 1 country sent glassware back (non-participation of Indonesia)
## Participation of Asian countries 2016-2019

<table>
<thead>
<tr>
<th>No</th>
<th>Country</th>
<th>Shipment of glassware</th>
<th>Date of shipment of glassware</th>
<th>Receipt of glassware</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cambodia</td>
<td>yes</td>
<td>10.01.2017</td>
<td>25.04.2017</td>
<td>1st shipment lost</td>
</tr>
<tr>
<td>2</td>
<td>Indonesia</td>
<td>yes</td>
<td>14.02.2017</td>
<td></td>
<td>glassware was sent back after a waiting time of 28 days returned to Freiburg on 05 06 2017</td>
</tr>
<tr>
<td>3</td>
<td>Lao PDR</td>
<td>yes</td>
<td>10.01.2017</td>
<td>23.01.2017</td>
<td>according to DHL tracking</td>
</tr>
<tr>
<td>4</td>
<td>Mongolia</td>
<td>yes</td>
<td>10.01.2017</td>
<td>30.01.2016</td>
<td>2 bottles broken, others opened by custom</td>
</tr>
<tr>
<td>5</td>
<td>Philippines</td>
<td>yes</td>
<td>14.02.2017; 15.12.2017</td>
<td>13.03.2018</td>
<td>1. glassware lost, was sent back to Freiburg April 18</td>
</tr>
<tr>
<td>6</td>
<td>Thailand</td>
<td>yes</td>
<td>15.12.2017</td>
<td>15.01.2018</td>
<td>12.1.2018 delivery not possible</td>
</tr>
<tr>
<td>7</td>
<td>Vietnam</td>
<td>yes</td>
<td>10.01.2017</td>
<td>04.04.2017</td>
<td>according to DHL</td>
</tr>
</tbody>
</table>

- 6 participants received glassware
- 2 countries ready to send human milk sample
STEP 3 - PRESERVATION

Refrigeration:

-4°C ≤ 72h

-20°C > 72h

Supply of dichromate tablets via distributor of chemicals in Germany?
Shipment of samples in close contact with Dr Karin Malisch

Coordination before shipment – preferably on Monday; no holidays

Express; frozen; cooling elements

Tracking number allowing to contact to customs in Germany !!!
### Compounds to be analysed in pooled national mothers milk samples by CVUA under this Agreement

<table>
<thead>
<tr>
<th>Year</th>
<th>POPs listed at COP-4</th>
<th>POPs listed at COP-5</th>
<th>POPs listed at COP-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>Initial POPs</td>
<td>Endosulfan</td>
<td>HBCD</td>
</tr>
<tr>
<td></td>
<td>Aldrin</td>
<td>α-, β-endosulfan; and endosulfan sulfate</td>
<td>α-HBCD, β-HBCD, γ-HBCD</td>
</tr>
<tr>
<td></td>
<td>Chlordane cis- and trans-chlordane; and cis- and trans-nonachlor, oxychlordane</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DDT 4,4'-DDT, 2,4'-DDT and 4,4'-DDE, 2,4'-DDE, 4,4'-DDD, 2,4'-DDD</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dieldrin</td>
<td>Dieldrin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Endrin</td>
<td>Endrin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HCB</td>
<td>HCB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heptachlor and heptachlorepoxide</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Mirex</td>
<td>Mirex</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PCB with TEFs* (12 congeners): 77, 81, 105, 114, 118, 123, 126, 156, 157, 167, 169, and 189</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PCDD/PCDF 2,3,7,8-substituted PCD/PCDF (17 congeners)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Toxaphene Congeners P26, P50, P62</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>* PCB with TEFs (Toxic Equivalency Factors) assigned by WHO in 1998</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>Chlordecone</td>
<td>Chlordecone</td>
<td></td>
</tr>
<tr>
<td></td>
<td>α-HCH</td>
<td>α-HCH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>β-HCH</td>
<td>β-HCH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>γ-HCH</td>
<td>γ-HCH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hexabromobiphenyl PBB 153</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pentachlorobenzene PeCBZ</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c-penta BDE BDE 47, 99, 153, 154, 175/183 (co-eluting)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c-octa BDE Optional: BDE 100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>POPs listed at COP-5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Endosulfan</td>
<td>α-, β-endosulfan; and endosulfan sulfate</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>POPs listed at COP-6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HBCD</td>
<td>α-HBCD, β-HBCD, γ-HBCD</td>
<td></td>
</tr>
</tbody>
</table>
Expert meeting to update the Global Monitoring Plan guidance document

Brno, Czech Republic, 7-9 November 2017

2. Introduction and context:

2015
(a) Outcomes of COP-7 and COP-8 relevant to the update of the global monitoring plan (GMP) guidance document;

2017
(b) Mandate and process for updating the GMP guidance document;

3. Experiences from monitoring programmes in sampling and analyzing the newly listed POPs in core matrices and other media:

(a) Hexachlorobutadiene;
(b) Pentachlorophenol and its salts and esters;
(c) Polychlorinated naphthalenes;
(d) Decabromodiphenyl ether (BDE-209);
(e) Short-chain chlorinated paraffins;
### Aim of CVUA Freiburg: inclusion also of voluntary POPs (COP 7, COP 8)

*except PFAS, analysed at University Örebro*

<table>
<thead>
<tr>
<th>Year</th>
<th>Mandatory (according to PCA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>1) Initial POPs: aldrin, chlordane, DDT, dieldrin, endrin, HCB, heptachlor, mirex, toxaphene, PCB, PCDD, PCDF</td>
</tr>
<tr>
<td>2009</td>
<td>2) POPs listed at COP-4: chlordecone, HCH (alpha, beta, gamma), hexabromobiphenyl (PBB 153), Pentachlorobenzene, PBDE (47, 99, 153, 175/183-co-eluting); optional: BDE 100; PFOS</td>
</tr>
<tr>
<td>2011</td>
<td>3) POPs listed at COP-5: endosulfan</td>
</tr>
<tr>
<td>2013</td>
<td>4) POPs listed at COP-6: HBCDD (alpha, beta, gamma)</td>
</tr>
</tbody>
</table>

### Voluntary:

<table>
<thead>
<tr>
<th>Year</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>5) POPs listed at COP-7: Hexachlorobutadiene (Annex A), pentachlorophenol + salts + esters, polychlorinated naphthalenes</td>
</tr>
<tr>
<td>2017</td>
<td>6) POPs listed at COP-8: Decabromodiphenyl ether, SCCP, hexachlorobutadiene (Annex C)</td>
</tr>
<tr>
<td>2019</td>
<td>7) possible candidates at COP-8: dicofol, pentadecafluorooctanoic acid (PFOA) and salts, perfluorohexane sulfonic acid (PFHxS)</td>
</tr>
</tbody>
</table>
Selected results and discussion – examples for a complex picture

Global WHO/UNEP-Studies 2000 - 2019

Asian countries 2016-2019
Aspects for differentiation

- **Parameters**
  - 23 parameters
  - (without congeners, metabolites …)

- **Regions**
  - Continents
  - Countries

- **Time trends**
Stockholm Convention on Persistent Organic Pollutants

Conference of the Parties to the Stockholm
Convention on Persistent Organic Pollutants
Sixth meeting
Geneva, 28 April–10 May 2013
Item 5 (i) of the provisional agenda

Matters related to the implementation of the Convention:
effectiveness evaluation

Results of the global survey on concentrations in human milk of persistent organic pollutants by the United Nations Environment Programme and the World Health Organization
Comparison of levels between countries

- **NO** „ranking“ between countries
- But identification of lower / middle / upper ranges

✓ **Goal:** findings allow setting priorities in different regions and countries
Asia

WHO-PCDD/F-TEQ (2005 / UB)

2000 - 2003
2004 - 2007
2008 - 2012

Hong Kong (2002)
Hong Kong (2009)

India

pg WHO-PCDD/F-TEQ (2005) / g lipid
PCP and dioxins in guar gum from India

RASFF, July 2007, notification from Switzerland:

Very high contamination levels of dioxins and pentachlorophenol (PCP) found in certain batches of guar gum from India:

- about 1000 times the level of what can be considered as normal background contamination
- 9 EU Member States affected
Guar gum

- extracted from guar bean
- use as thickening, emulsifying, binding, gelling additive
- India produces about 80% of world market
- **Food grade** guar gum: authorised as food additive
- **Industrial grade** guar gum: for non-food uses, e.g. in printing and textile industry

- Technical note (2004): guar gum used as printing thickener for printing inks on textile (in particular in textiles made from polyester). Frequently/often preserved with pentachlorophenol (PCP).
Two EU missions to India (2007, 2009)

Na-PCP extensively used in India for industrial grade guar gum
- either sold as food grade
- or cross-contamination from industrial to food grade gums

Detection in food grade guar gum points to use for textiles –
- elimination of sources is quite complex
  (environment, food, …)
Egypt

Main source of dioxins is waste incineration
Geophagia

- Consumption of clay quite common among ethnic minorities in the Netherlands, UK and certain parts of the population in Africa

- Consumption of clay by pregnant women
  - use against morning sickness, but also source of minerals
Clays collected from Africa (n=20)

- Increased dioxin levels in some of the clays with a highest observed level of 103 ng TEQ/kg
Food and Drug Administration (USA), 1997:

- **Ball clay (bentonite) as source of dioxin contamination** in poultry, commercial catfish and eggs
- Used as **feed additive** (to soybean meal, as flowing or anticaking agent)
- Origin: mine in Mississippi
EU, 1999:

- Caolinitic clay as source of dioxin contamination
- Feed additive (anticaking agent)
- Origin: mine in Germany
- Same PCDD/F pattern as in clay from Mississippi (OCDD-dominated; no furans; similar to PCP)
- Range of contamination:
  > 100,000 to > 500,000 pg WHO-TEQ/kg
Obvious: natural source

- Possibly, geological processes formed this unique pattern of dioxins over time from organic material and chlorine.
Conclusions for breast milk from Ivory Coast and Congo

- Dioxin pattern in clays can explain pattern in human milk
- Use of clay likely to be responsible for elevated dioxin levels in breast milk from some African countries
- Potential risk
Temporal trend of PCDD/F in human milk
(pg WHO-PCDD/F-TEQ/g lipid; TEF-2005)
SUM DDTs

Legend

- Light yellow: 26 – 725 ng Sum DDT/g lipid
- Yellow: 725 – 1740 ng Sum DDT/g lipid
- Orange: 1740 – 4320 ng Sum DDT/g lipid
- Dark red: 4320 – 7640 ng Sum DDT/g lipid
- Maroon: 7640 – 22300 ng Sum DDT/g lipid
Median levels of DDT (ng/g lipid)

Max: 23500 ng sum DDT/g lipid (= 23.5 mg/kg)
Composition of technical DDT (%)
Contribution (%) to Sum DDT in humans

(all samples except from Ethiopia and Djibouti, median of 97 samples)
Technical HCH:

- **Alpha-HCH** (65 – 70 %)
- **Beta-HCH** (7 – 20 %)
- **Gamma-HCH** (14 – 15 %)
Beta-HCH
Gamma-HCH

gamma-hexachlorocyclohexane (HCH)
Sum PBDE

No increase of PBDD/F-levels with increasing PBDE levels
Perfluorinated compounds (PFCs)

- Lack of lipophilicity results in relatively low levels in milk compared to serum/blood (distribution milk/serum ~1:100).
- Distribution varies for different PFCs.
- More reliable data would be generated using blood/serum.

PFOS
Chlorinated Paraffins (CPs)

- general formula: $C_nH_{2n+2-z}Cl_z$
- variation of chain length, number and position of chlorines
  - short chain CPs (SCCP; C10 – C13)
  - medium chain CPs (MCCP; C14 – C17)
  - long chain CPs (LCCP; > C17)
- complex mixtures: > 10,000 compounds
- chlorine content of commercially available mixtures: between 30 – 70%
Stockholm Convention POPs in breast milk
(ng/g lipid)
Stockholm Convention POPs in breast milk
(ng/g lipid)
Stockholm Convention POPs in breast milk
(pg/g lipid resp. ng/g lipid)
WHO recommendation over last decades

- Support and promotion of exclusive breastfeeding for the first six months
Risk evaluation of breast feeding with regard to concentrations of PCDDs, PCDFs, PCBs and DDTs

WHO/UNEP global surveys of PCDDs, PCDFs, PCBs and DDTs in human milk and benefit–risk evaluation of breastfeeding

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August 2016
Risk evaluation of breast feeding with regard to concentrations of PCDDs, PCDFs, PCBs and DDTs

Conclusions from several studies:

- Prenatal exposure to these compounds is more important for effects than breastfeeding itself
Safety standards for human milk

**Recommended intake for (PCDD/F + dl-PCB)-TEQ**

- European Commission, Scientific Committee on Food (2001): tolerable weekly intake (TWI) of 14 pg WHO-TEQ/kg bw
- Joint FAO/WHO Expert Committee on Food Additives (JECFA) (2001): provisional tolerable monthly intake (PTMI) of 70 pg WHO-TEQ/kg bw/month
- US EPA (2010): oral reference dose (RfD) of 0.7 pg TCDD/kg bw/day

**Recommended intake for DDT**

- WHO (2001): provisional tolerable daily intake (TDI) of 10 μg/kg bw
- US EPA and ATSDR (2011): oral reference dose (RfD) of 0.5 μg/kg bw/day
Recommended daily intake

- TDI, TWI, PTMI, RfD: meant for chronic life time exposure
- Not applicable to breastfeeding situation (covering a much shorter period of life – with exceedance of TWI/PTMI with one or two order of magnitudes)
Comparison of results for human milk from WHO/UNEP studies (2000 – 2012) with „safe“ levels

<table>
<thead>
<tr>
<th>Safety standards as &quot;Equivalent milk level&quot;</th>
<th>WHO-PCDD/F-PCB-TEQ (2005 / UB)</th>
<th>Total PCBs *)</th>
<th>Sum DDT **)</th>
</tr>
</thead>
<tbody>
<tr>
<td>unit</td>
<td>pg/g lipid</td>
<td>ng/g lipid</td>
<td>ng/g lipid</td>
</tr>
<tr>
<td>Min</td>
<td>0.2 – 0.9</td>
<td>7</td>
<td>2300</td>
</tr>
<tr>
<td>25th perc.</td>
<td>1.5</td>
<td>2</td>
<td>23</td>
</tr>
<tr>
<td>Median</td>
<td>5.6</td>
<td>18</td>
<td>171</td>
</tr>
<tr>
<td>75th perc.</td>
<td>9.4</td>
<td>38</td>
<td>396</td>
</tr>
<tr>
<td>90th perc.</td>
<td>14.3</td>
<td>121</td>
<td>1015</td>
</tr>
<tr>
<td>95th perc.</td>
<td>20.3</td>
<td>223</td>
<td>1849</td>
</tr>
<tr>
<td>Max</td>
<td>23.7</td>
<td>347</td>
<td>2616</td>
</tr>
<tr>
<td></td>
<td>49.0</td>
<td>1009</td>
<td>23472</td>
</tr>
</tbody>
</table>

*) in human milk as sum of 6 indicator PCBs
**) in human milk calculated after correction of metabolites for molecular weight
CONCLUSIONS (1):

- Human milk levels of PCDDs, PCDFs and PCBs are still significantly above those considered safe.
- ΣDDTs are below or around those considered safe in most countries.
- In comparison to pooled samples, individual samples will show some variation.
- Picture gets more complex, if other POPs included.
CONCLUSIONS (2):

- With respect to potential adverse health effects, *in utero* exposure is more important than lactational exposure.
- If potential adverse effects are balanced against positive health aspects for (breastfed) infants, the advantages of breastfeeding far outweigh the possible disadvantages.
- In view of the importance of *in utero* exposure due to maternal body burdens, all efforts should still be directed to further reducing human dietary and environmental exposure to these POPs.
Outlook

Complex evaluation possible after performance of 7th round based on cost-effective study with pooled human milk samples (as end-point of bioaccumulation)

✓ Regional differentiation allowing identification of priorities for follow-up with regard to wide range of POPs (including new POPs)

✓ Effectiveness Evaluation: Time trends for countries with repeated participation
Thank you!