Midterm Workshop of the UN Environment/GEF project
´Continuing Regional Support for the POPs Global Monitoring Plan under the Stockholm Convention'
in the Africa Region
Lusaka, Zambia, 23-25 July 2018

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

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(State Institute for Chemical and Veterinary Analysis of Food)

- ✓ 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

Round	Years	Organized by	No of countries	Parameters
1	1987-1988	WHO-EURO	12	Dioxins and PCBs
2	1992-1993	WHO-EURO	19	Dioxins and PCBs
3	2000-2003	WHO-EURO	26	Dioxins and PCBs
				later Stockholm Convention Initial POPs
4	2004-2007	WHO/UNEP	13	Stockholm Convention POPs
5	2008-2011	WHO/UNEP	45	Stockholm Convention POPs
6	2012-2015	UNEP	17	Stockholm Convention POPs
7	since 2016	UNEP	42	Stockholm Convention POPs

Participants 2000 - 2015

Africa	2000-2003	2004-2007	2008-2011	2012-2015
Congo (DR)			x	
Côte d'Ivoire			x	x
Djibouti			x	
Egypt	x			
Ethiopia				x
Ghana			x	
Kenya			x	
Mali			x	
Mauritius			x	
Niger			x	x
Nigeria			x	
Senegal			x	
Sudan		x		
Togo			x	
Uganda			x	
total no: 15				

America	2000-2003	2004-2007	2008-2011	2012-2015
Antigua-Barb.			x	
Barbados			x	
Brazil	x			x
Chile			2 x	
Cuba			x	
Haiti		x	x	x
Jamaica			x	
Mexico			x	
Peru			x	
Suriname				x
Uruguay			x	
USA	x			
total no: 12				

Asia	2000-2003	2004-2007	2008-2011	2012-2015
Hong Kong SAR	x		x	
India			x	
Indonesia			x	
Israel				x
Korea (Rep)			x	
Philippines	x			
Syria			x	
Tajikistan			x	
total no: 8				

Australia, NZ, Pacific Islands	2000-2003	2004-2007	2008-2011	2012-2015
Australia	x		x	x
Fiji	x	x	x	
Kiribati		x	x	
Marshall Islands			x	
New Zealand	x		x	
Niue			x	
Palau			x	
Samoa			x	
Solomon Islands			x	
Tonga			x	
Tuvalu			x	
total no: 11				

Europe	2000-2003	2004-2007	2008-2011	2012-2015
Belgium	x	x	x	x
Bulgaria	x			x
Croatia	x			x
Cyprus		x		
Czech Rep	x	x		x
Finland	x	x		
Georgia			x	x
Germany	x			
Hungary	x	x		
Ireland	x		x	
Italy	x			
Lithuania			x	x
Luxembourg	x	x		
Moldova			x	x
Netherlands	x			x
Norway	x	x		
Romania	x			x
Russia	x			
Slovak Rep	x	x		
Spain	x			
Sweden	x	x		
Switzerland			x	
Ukraine	x			
total no: 23				

total number of countries:	69
from these participating	
- once	43
- twice	21
- three times	4
- four times	1
resulting number of country/year-data:	*101*
total number of pooled samples:	188

Africa					
	2000-2003	2004-2007	2008-2011	2012-2015	2016-2019
Congo (DR)			x		x
Côte d'Ivoire			x	x	
Djibouti			x		
Egypt	x				x
Ethiopia				x	x
Ghana			x		x
Kenya			x		x
Mali			x		x
Mauritius			x		x
Morocco					x
Niger			x	x	
Nigeria			x		x
Senegal			x		x
Sudan		x			
Tanzania					x
Tunisia					x
Togo			x		x
Uganda			x		x
Zambia					x
total no: 19 (2016-2019: 15)					

Participants from Africa 2000 - 2019

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 <u>one</u>** pooled (=mixed) sample **<u>representative</u>** 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?

Support of capacity building

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.)

50 ml

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

25 ml

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

Guidelines

UNEP-coordinated Survey of Human Milk for Persistent Organic Pollutants

Guidelines for Organization, Sampling and Analysis

January 2017

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

Video on guidelines

https://youtu.be/7LwJ0x2_PXQ

Preparing the video:

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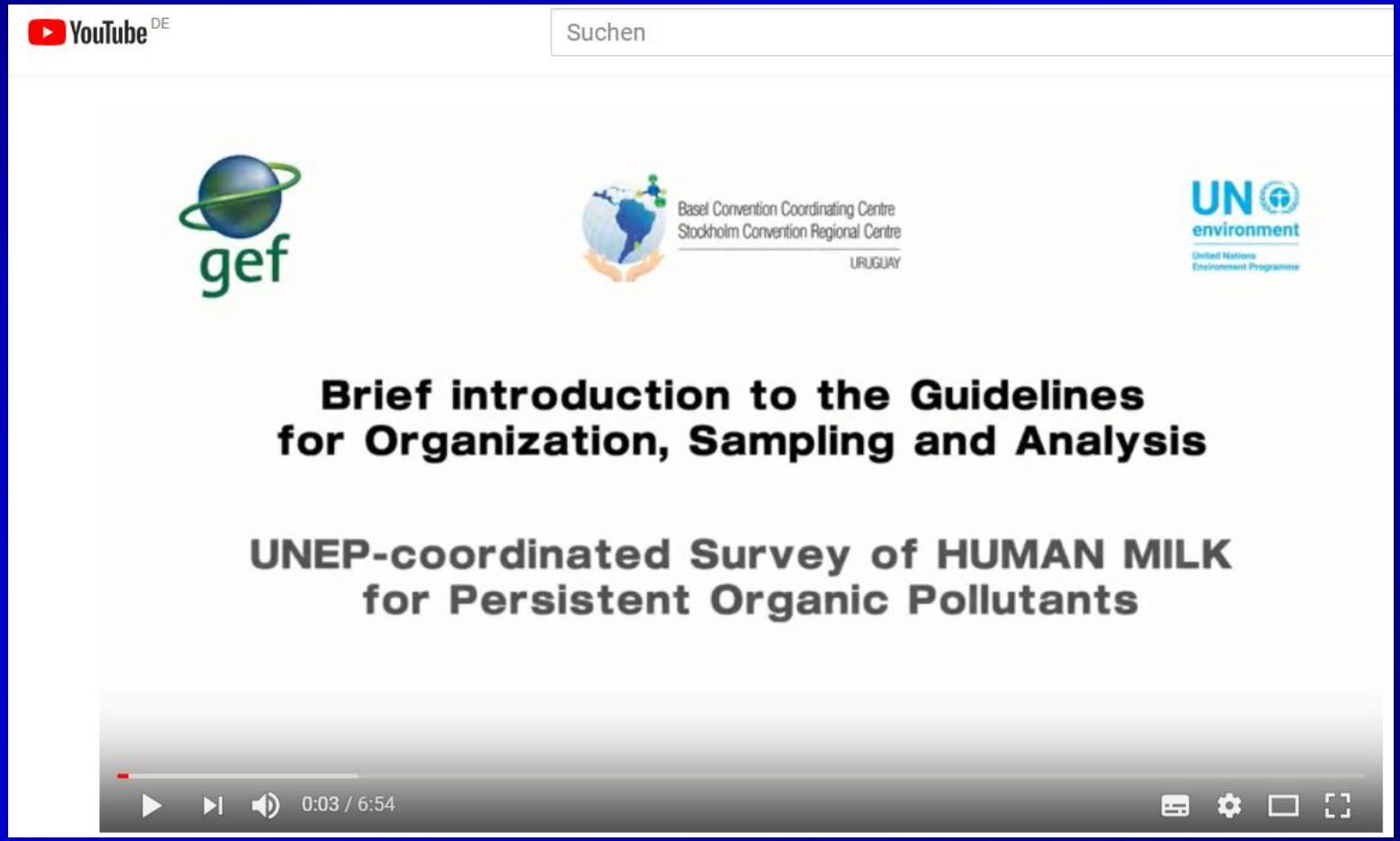


Project Cooperation Agreement (PCA), part I: shipment of glassware containers

(here: 15 countries from Africa)

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

➢ **All countries received glassware (60 x 100 ml; 1 x 2000 ml);**

Participation of African countries 2016-2019

No	Country	Shipment of glassware	Date of shipment of glassware	Receipt of glassware	Announcement / info on shipment of human milk samples	additional infos of UNEP	Date of shipment of samples	Receipt of samples (date)	amount of milk sample
1	DR Kongo	yes	08.12.2016	15.03.2017	planned 13.11. 2017	done	14.11.2017	22.11.2017	1150 ml
2	Egypt	yes	08.12.2016	25.12.2016	Started in October 2017, finished hopefully first quarter of 2018				
3	Ethiopia	yes	08.12.2016	27.02.2017		going through ethical clearance			
4	Ghana	yes	08.12.2016	11.01.2017		going through ethical clearance			
5	Kenya	yes	08.12.2016	13.02.2017	planned April 18	going through ethical clearance, planned end of April			
6	Mali	yes	08.12.2016	13.02.2017		planned to start soon			
7	Mauritius	yes	08.12.2016	11.01.2017	clearance . 28.02.18:	details; Waiting for ethical clearance to start sampling, donor	planned 16 06 2018	21.06.2018	1200 ml
8	Morocco	yes	08.12.2016	13.01.2017		planned to start soon			
9	Nigeria	yes	08.12.2016	07.02.2017	01. 2018: ethical clearar	started			
10	Senegal	yes	15.12.2016	16.03.2017		ongoing	28.03.2018	03.04.2018	1200 ml
11	Tanzania	yes	15.12.2016	28.12.2017		planned to start soon			
12	Togo	yes	15.12.2016	03.01.2017	13.11.2017	done	13.11.2017	16.11.2017	1250 ml
13	Tunisia	yes	15.12.2016	22.05.2017		ongoing			
14	Uganda	yes	10.01.2017	03.02.2017		planned shipment end of May	10.06.2018	14.06.2018	1200 ml
15	Zambia	yes	10.01.2017	01.03.2017		ongoing, hopefully finished February 2018			

✓ **15 participants received glassware**

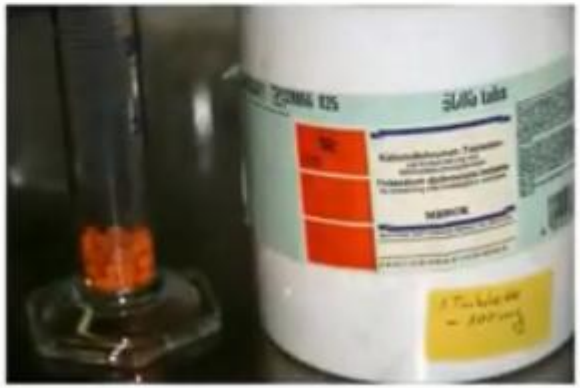
✓ **5 countries sent human milk samples**

STEP 3 - PRESERVATION

Refrigeration:

-4° C ≤ 72h

-20° C > 72h



Supply of dichromate tablets via distributor of chemicals in Germany?

STEP 5 - TRANSPORT

by express shipment

The shipment of the pooled samples
should be done in close cooperation
with Karin Malisch who should be informed
about date of shipment and tracking number
for follow-up of the shipment
and in particular solving possible problems
at customs in Germany and to avoid
any problems of possible delays
due to shipment at inappropriate times

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D-79114 Freiburg

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 !!!

Project Cooperation Agreement (PCA), part II: analysis – compounds to be analysed in pooled national mother's milk samples

Compounds to be analysed in pooled national mothers milk samples by CVUA under this Agreement	
Initial POPs	
Aldrin	Aldrin
Chlordane	*cis*- and *trans*-chlordane; and *cis*- and *trans*-nonachlor, oxychlordane
DDT	4,4'-DDT, 2,4'-DDT and 4,4'-DDE, 2,4'-DDE, 4,4'-DDD, 2,4'-DDD
Dieldrin	Dieldrin
Endrin	Endrin
HCB	HCB
Heptachlor	Heptachlor and heptachlorepoxide
Mirex	Mirex
PCB	ΣPCB_6 (6 congeners): 28, 52, 101, 138, 153, and 180
	PCB with TEFs* (12 congeners): 77, 81, 105, 114, 118, 123, 126, 156, 157, 167, 169, and 189
PCDD/PCDF	2,3,7,8-substituted PCD/PCDF (17 congeners)
Toxaphene	Congeners P26, P50, P62

* PCB with TEFs (Toxic Equivalency Factors) assigned by WHO in 1998

POPs listed at COP-4	
Chlordecone	Chlordecone
α-HCH	α-HCH
β-HCH	β-HCH
γ-HCH	γ-HCH
Hexabromobiphenyl	PBB 153
Pentachlorobenzene	PeCBz
c-penta BDE	BDE 47, 99, 153, 154, 175/183 (co-eluting)
c-octa BDE	Optional: BDE 100
POPs listed at COP-5	
Endosulfan	α-, β-endosulfan; and endosulfan sulfate
POPs listed at COP-6	
HBCD	α-HBCD, β-HBCD, γ-HBCD

Expert meeting to update the Global Monitoring Plan guidance document

Brno, Czech Republic, 7-9 November 2017

2. Introduction and context:

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

   (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)

mandatory (according to PCA)
1) Initial POPs: aldrin, chlordane, DDT, dieldrin, endrin, HCB, heptachlor, mirex, toxaphene, PCB, PCDD, PCDF
2) POPs listed at COP-4: chlordecone, HCH (alpha, beta, gamma), hexabromobiphenyl (PBB 153), Pentachlorbenzene, PBDE (47, 99, 153, 175/183-co-eluting); optional: BDE 100; PFOS
3) POPs listed at COP-5: endosulfan
4) POPs listed at COP-6: HBCDD (alpha, beta, gamma)
voluntary:
5) POPs listed at COP-7: Hexachlorobutadiene (Annex A), pentachlorophenol + salts + esters, polychlorinated napthalenes
6) POPs listed at COP-8: Decabromodiphenyl ether, SCCP, hexachlorobutadiene (Annex C)
7) possible candidates at COP-8: dicofol, pentadecafluorooctanoic acid (PFOA) and salts, perfluorohexane sulfonic acid (PFHxS)

Selected results and discussion – examples for a complex picture

Participation of African countries 2016-2019

As part of a more complex picture of

Global WHO/UNEP-Studies 2000 - 2019

Aspects for differentiation

- ✓ **Parameters**
  23 parameters
  (without congeners, metabolites …)
- ✓ **Regions**
  - ➢ **Continents**
  - ➢ **Countries**
- ✓ **Time trends**

UNITED NATIONS

UNEP

SC

UNEP/POPS/COP.6/INF/33

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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*

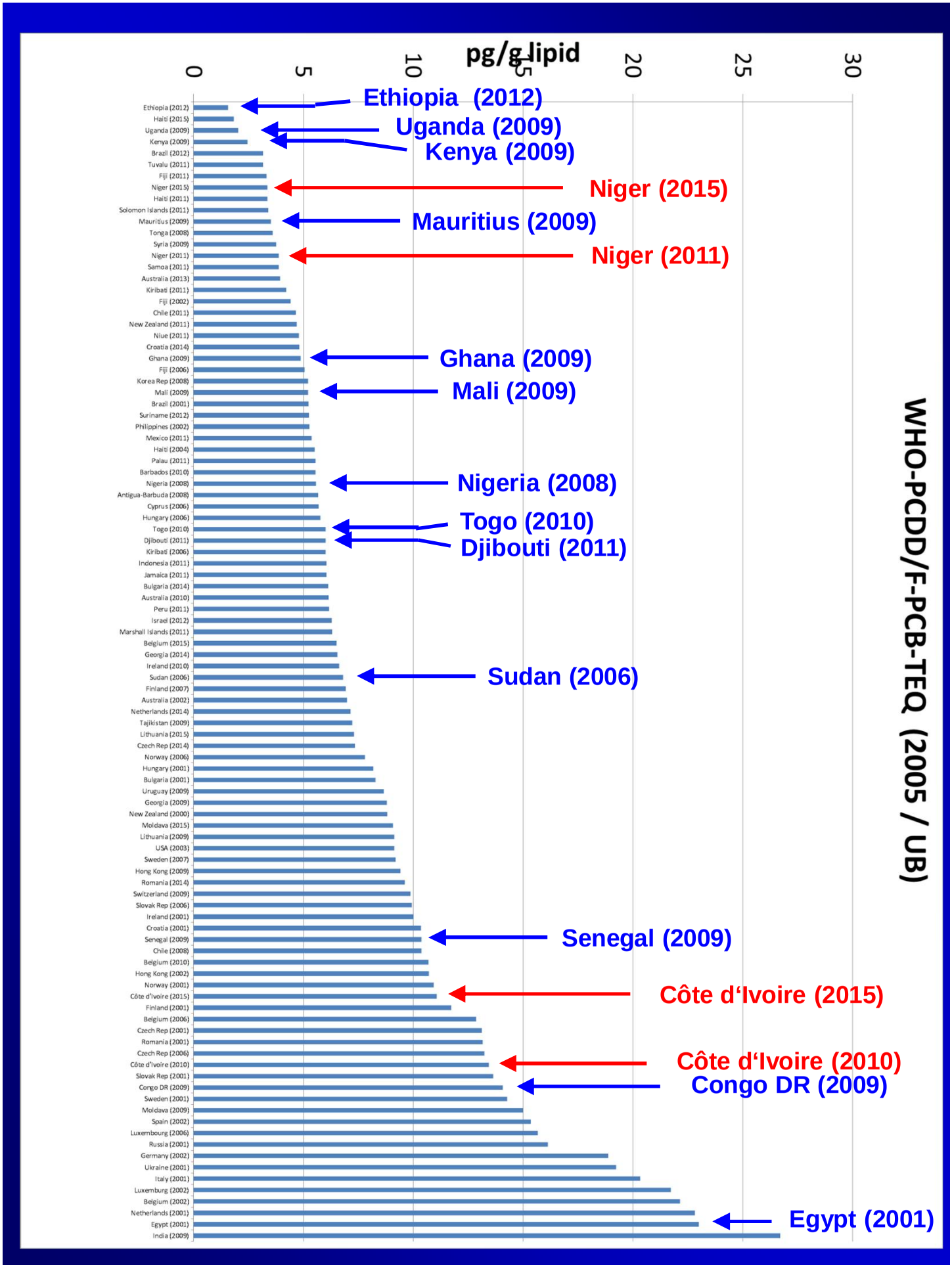
Matters related to the implementation of the Convention: effectiveness evaluation

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

WHO-PCDD/F-PCB-TEQ

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**


pg/g lipid
0
5
10
15
20
25
30
WHO-PCDD/F-PCB-TEQ (2005 / UB)
Ethiopia (2012)
Haiti (2015)
Uganda (2009)
Kenya (2009)
Brazil (2012)
Tuvalu (2011)
Fiji (2011)
Niger (2015)
Haiti (2011)
Solomon Islands (2011)
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Tonga (2008)
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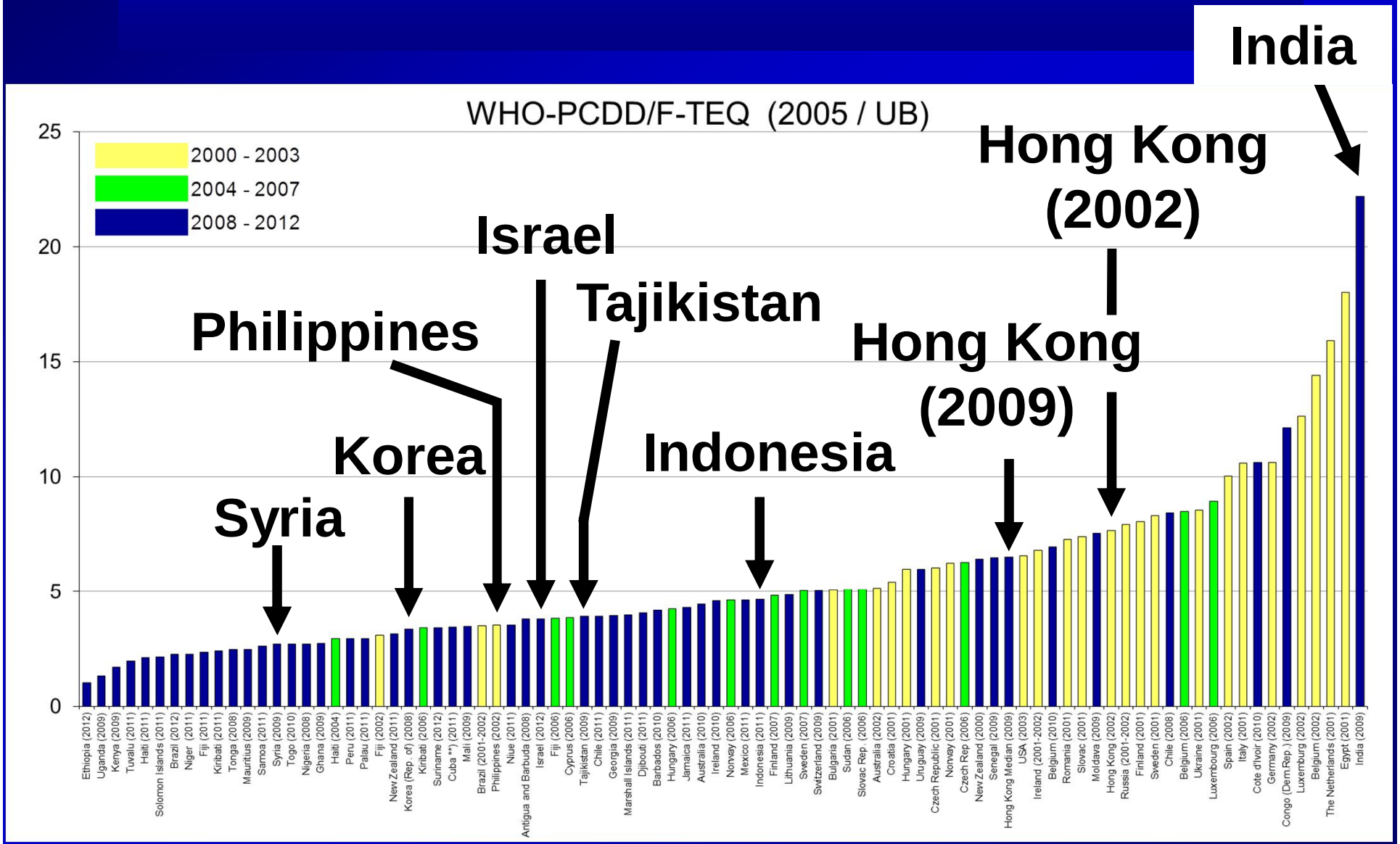
Senegal (2009)
Côte d'Ivoire (2015)
Côte d'Ivoire (2010)
Congo DR (2009)
Egypt (2001)

Asia



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

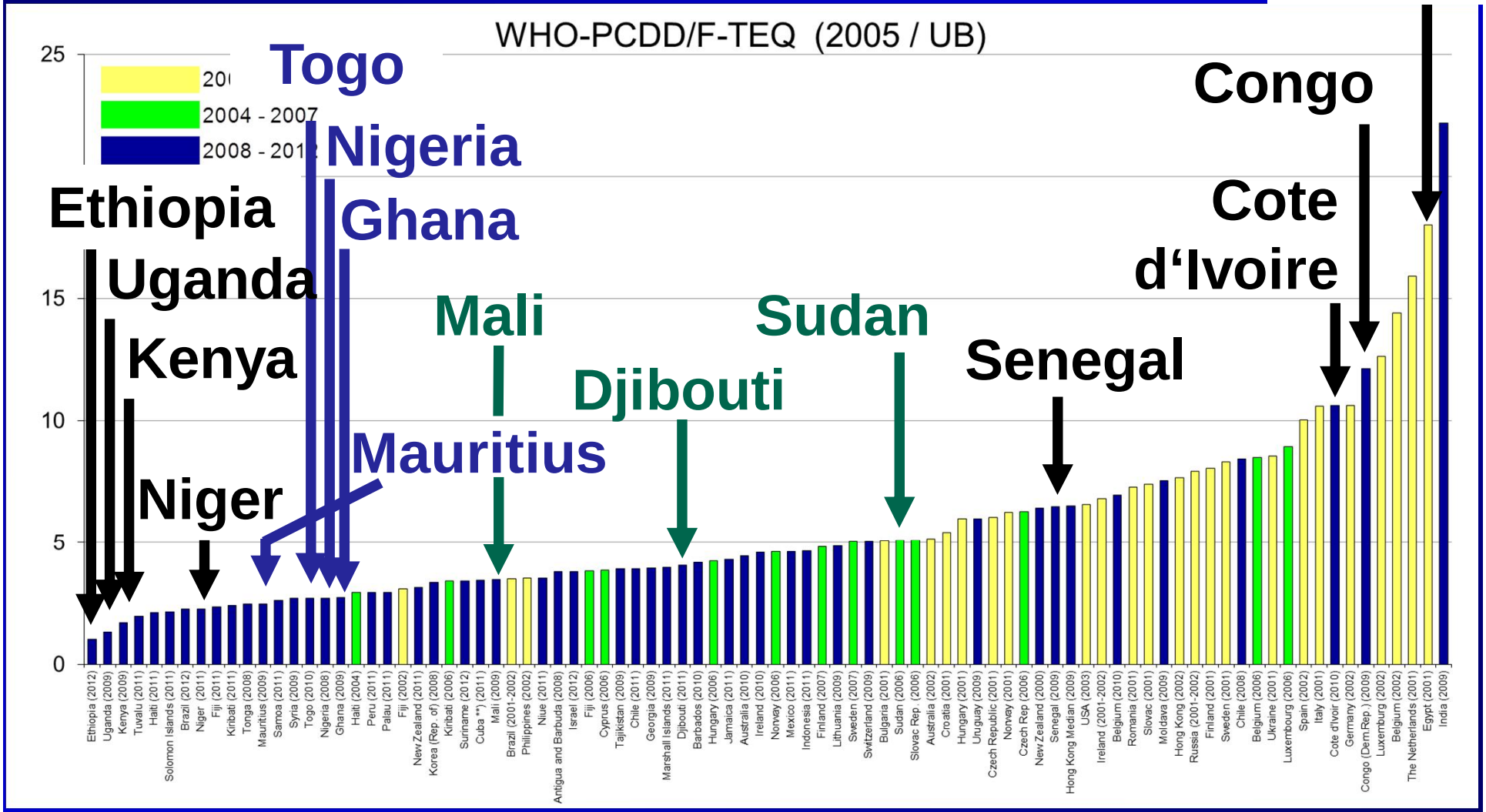
- either sold as food grade
- or cross-contamination from industrial to food grade gums

Detection in food grade guar gum points to use for textiles –

- **elimination of sources is quite complex (environment, food, …)**

Africa

(3 rounds 2000 -2011)



pg WHO-PCDD/F-TEQ (2005) / g lipid

Egypt

According to Ministry of State for Environmental Affairs, Egyption Environmental Affairs Agency:

- **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**

RIKILT
INSTITUTE OF FOOD SAFETY
WAGENINGEN UR

Ball clay / caolinitic clay I

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

Ball clay / caolinitic clay II

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

Ball clay / caolinitic clay III

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

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journal homepage: www.elsevier.com/locate/chemosphere

Dioxins (polychlorinated dibenzo-p-dioxins and polychlorinated dibenzo-furans) in traditional clay products used during pregnancy

Noortje M. Reeuwijk [a,*], Antonia Talidda [b], Rainer Malisch [c,d], Alexander Kotz [c,d], Angelika Tritscher [e], Heidelore Fiedler [f], Marco J. Zeilmaker [g], Martin Kooijman [a], Koen J.H. Wienk [a], Wim A. Traag [b], Ron L.A.P. Hoogenboom [b]

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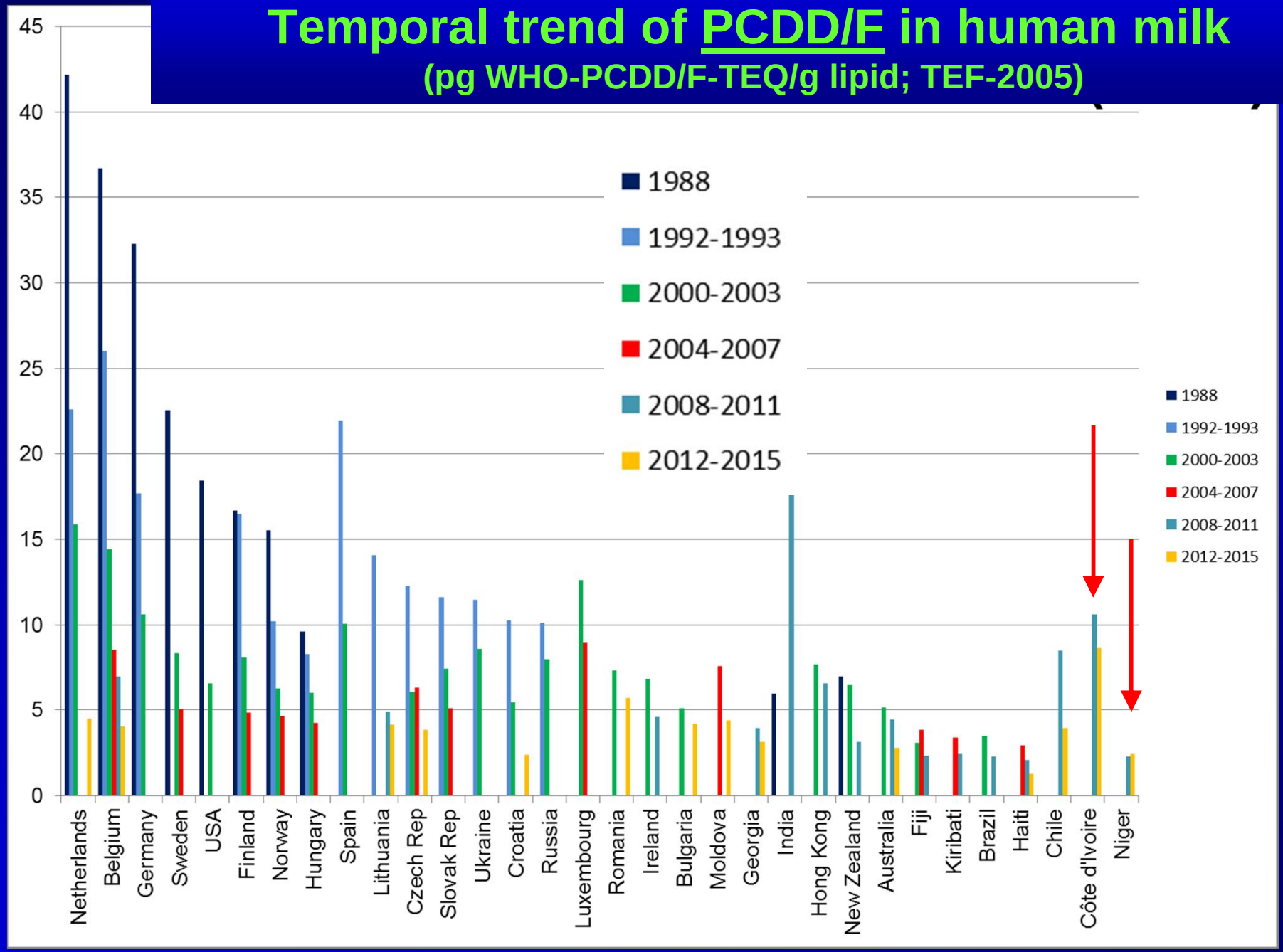
HIGHLIGHTS

- We determined PCDD/F levels of clays taken orally during pregnancy.
- PCDD/F levels in some clays were high, up to 103 ng TEQ kg^{-1}.
- We compared congener patterns of clay and human milk samples from Africa.
- PCDD/F patterns in some breast milk suggest a relationship with clay consumption.
- Use of contaminated clay presents a health risk for the developing fetus.

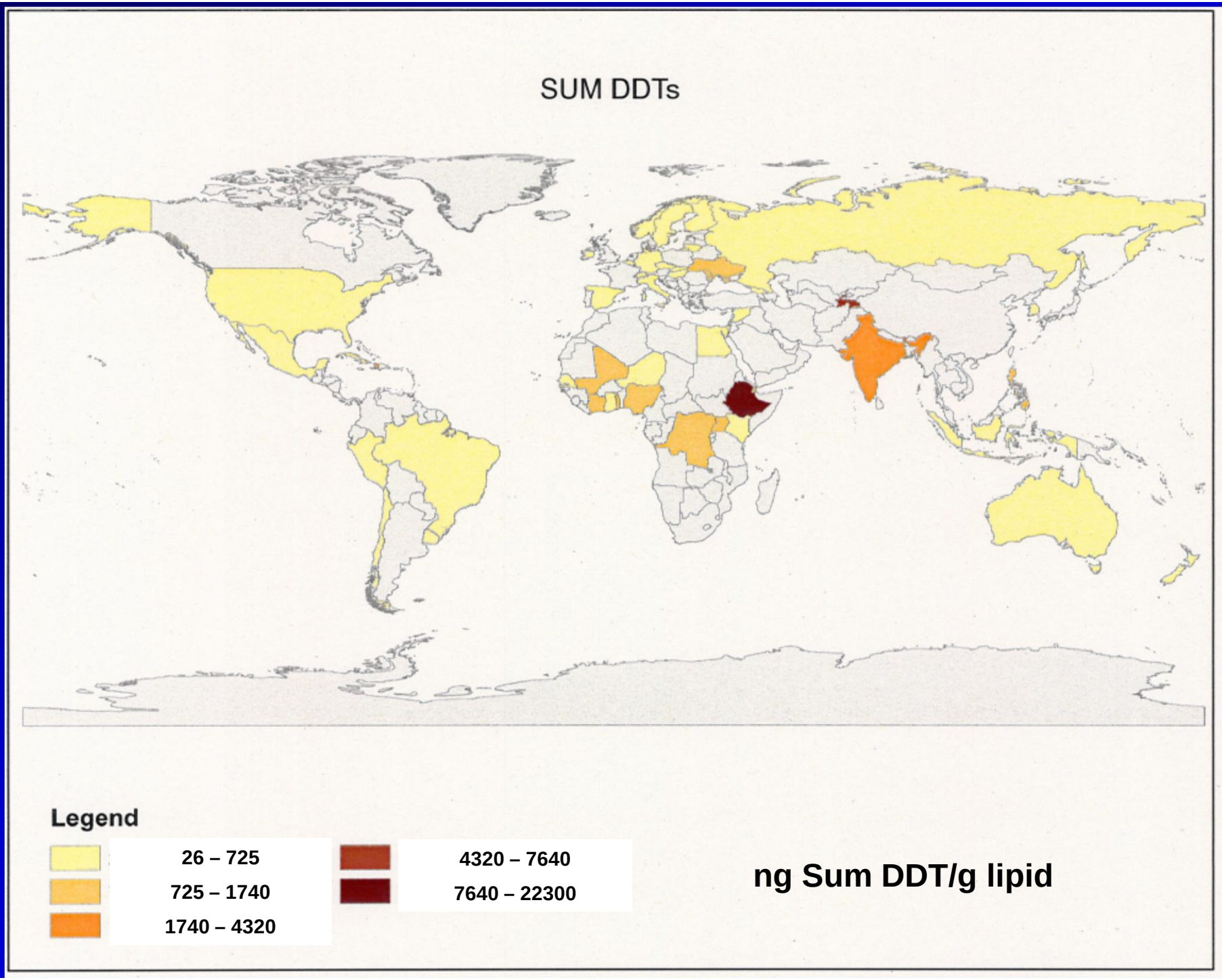
Time trends

Temporal trend of PCDD/F in human milk

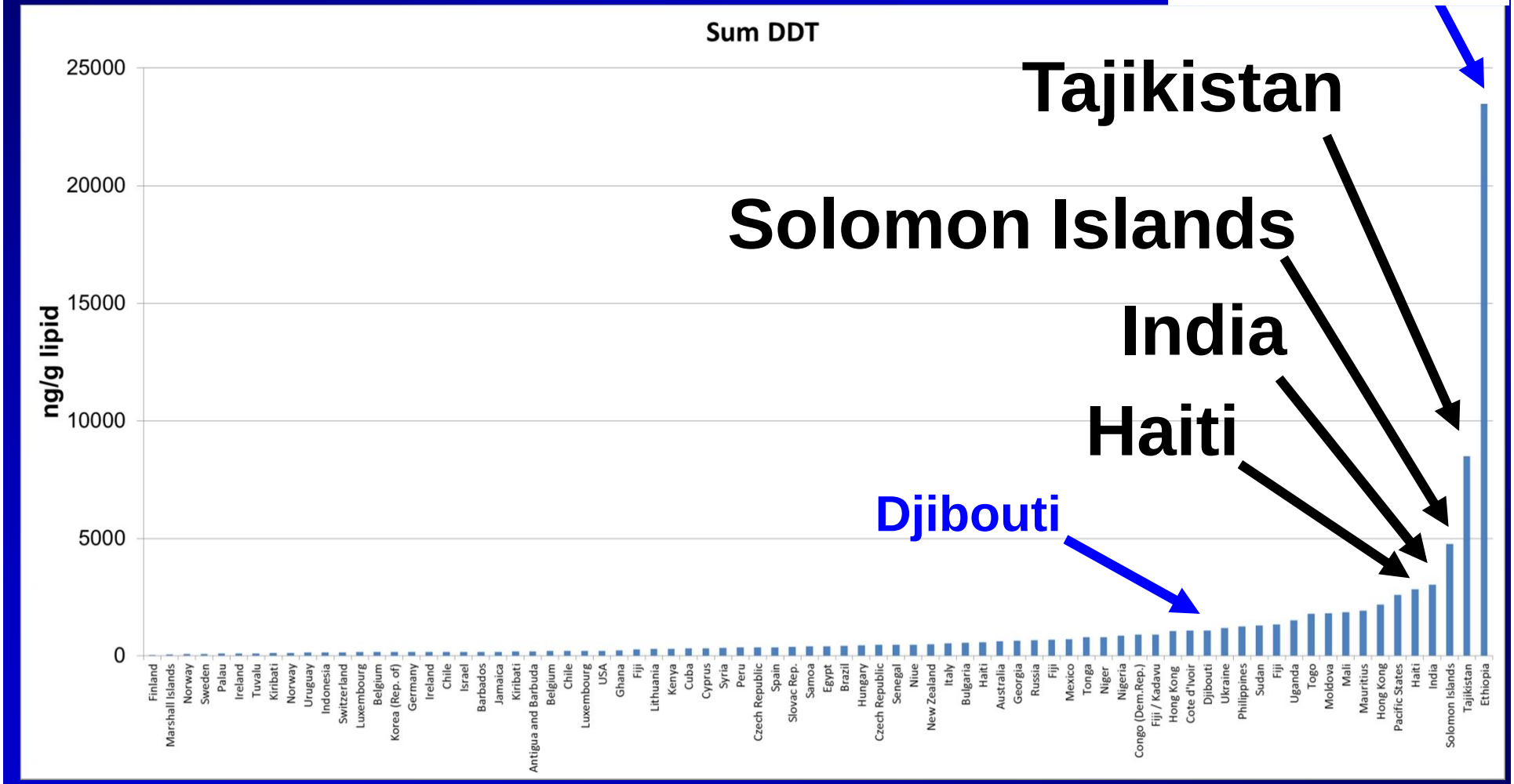
(pg WHO-PCDD/F-TEQ/g lipid; TEF-2005)



DDT

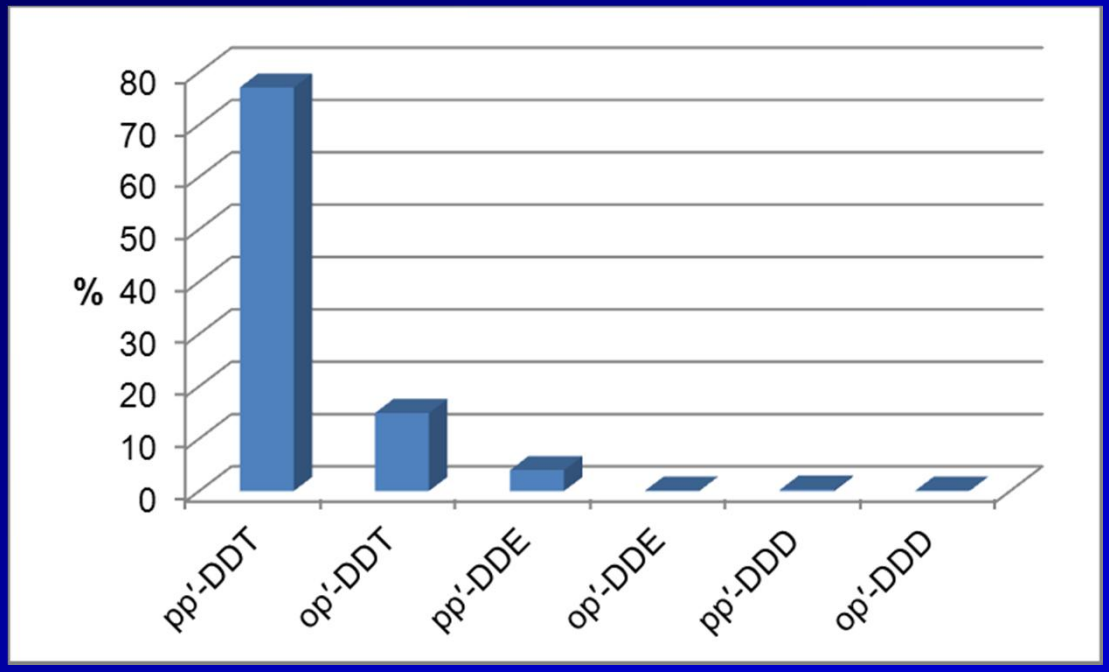

SUM DDTs
Legend
26 – 725
725 – 1740
1740 – 4320
4320 – 7640
7640 – 22300
ng Sum DDT/g lipid

Median levels of DDT (ng/g lipid)

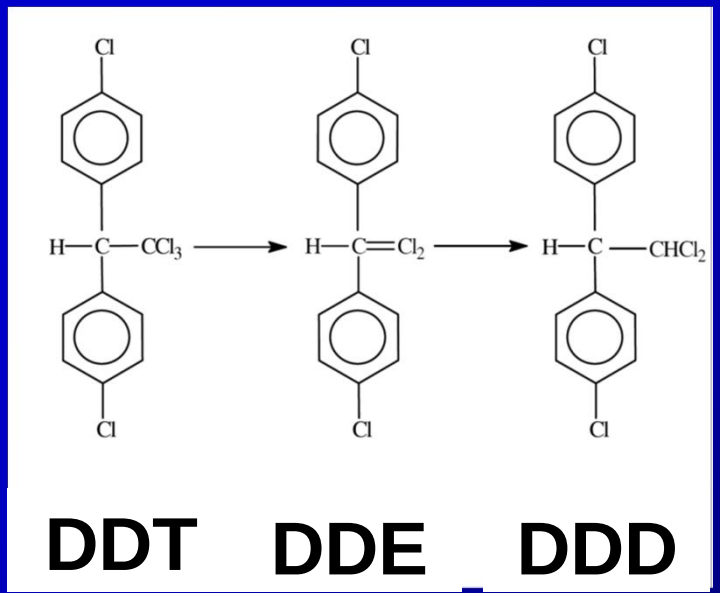


Max: 23500 ng sum DDT/g lipid *(= 23.5 mg/kg)*

DDT

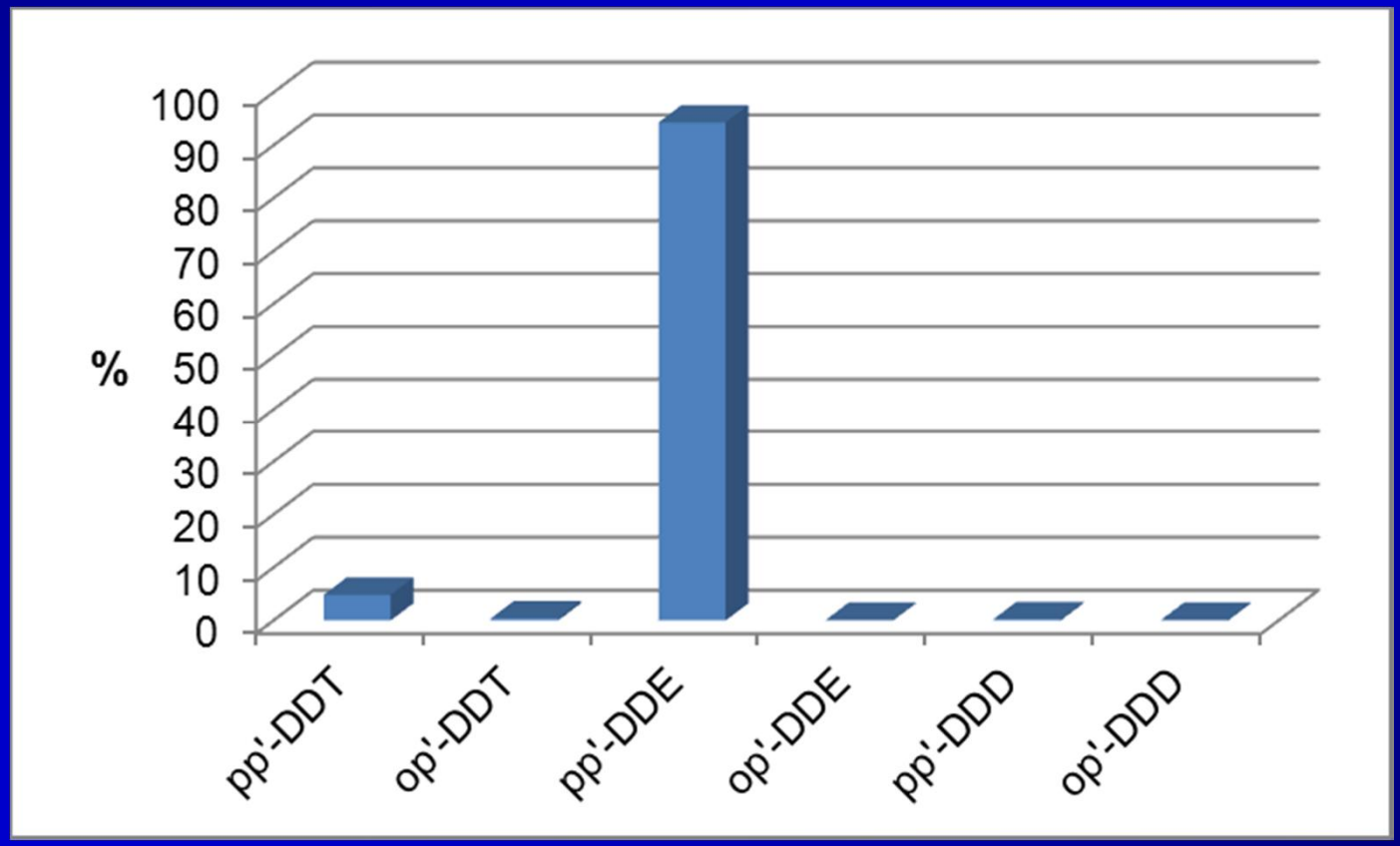


Composition of technical DDT (%)



Contribution (%) to Sum DDT in humans

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



DDT

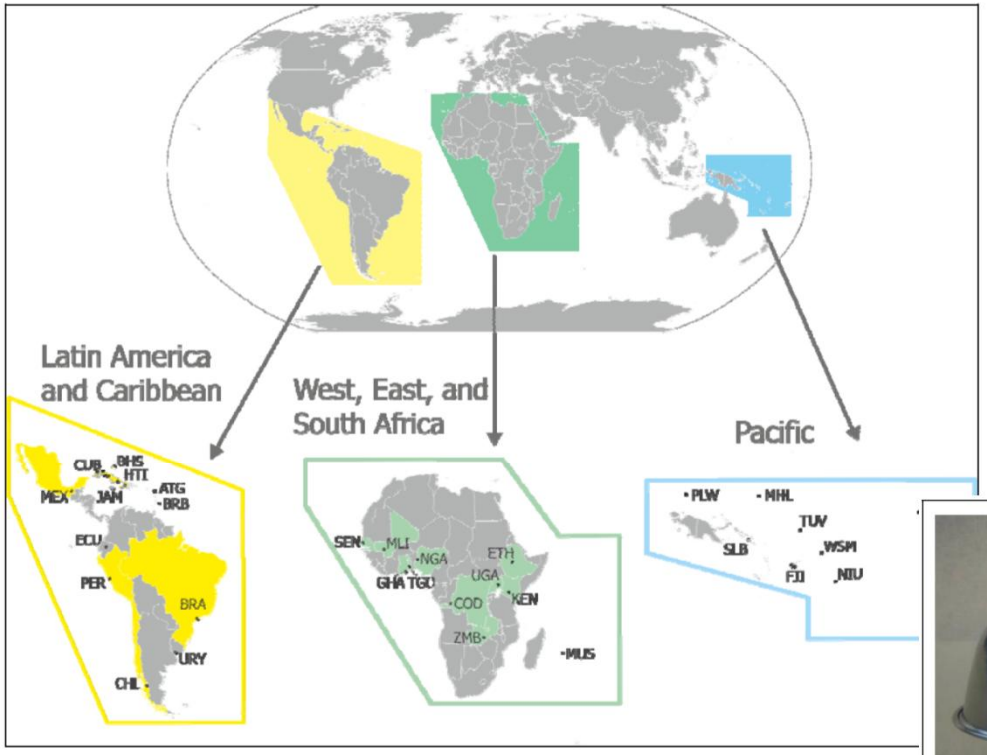
	Sum DDT µg/kg lipid	pp'-DDE %	pp'-DDT %
Djibouti	1080	69	26
Ethiopia	23500	50	46

Two pillars:

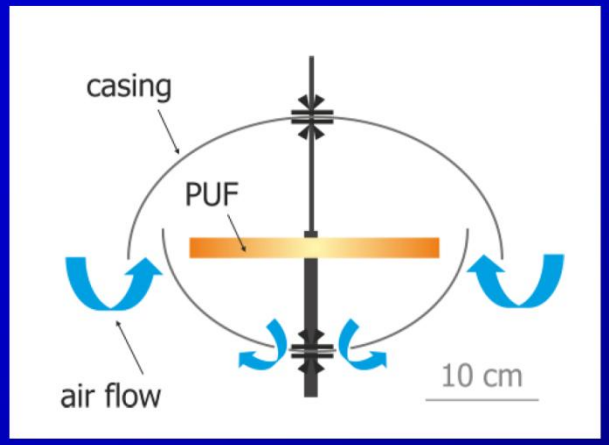
Air and human milk – comparison

Air

Report on Passive Air Sampling under the Global Monitoring Plan for Persistent Organic Pollutants - GMP Projects 2010-2011



Adsorbent: polyurethane foam (PUF)



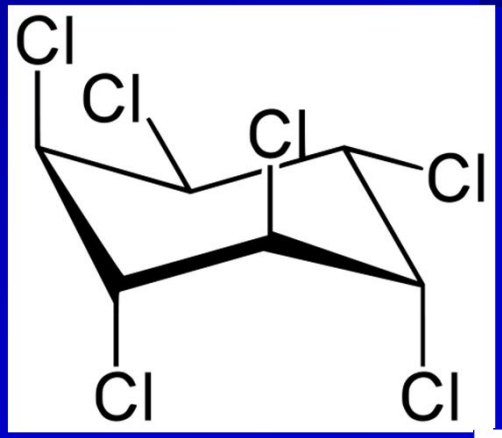
UNEP, 2012

HCH

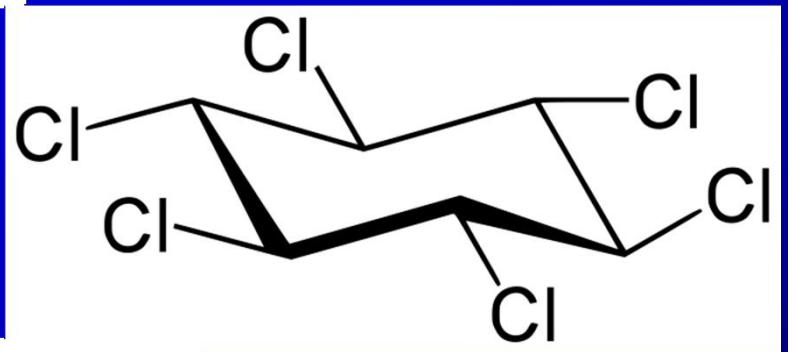
Technical HCH:

HCH

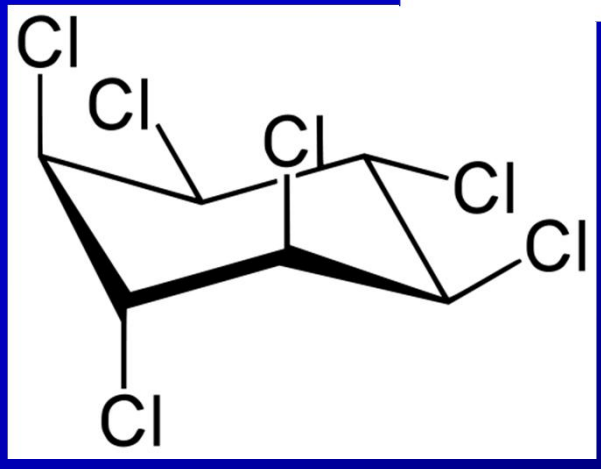
- ✓ **Alpha-HCH** (65 – 70 %)



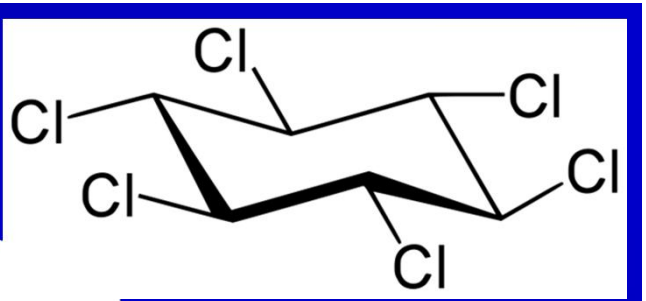
- ✓ **Beta-HCH** (7 – 20 %)

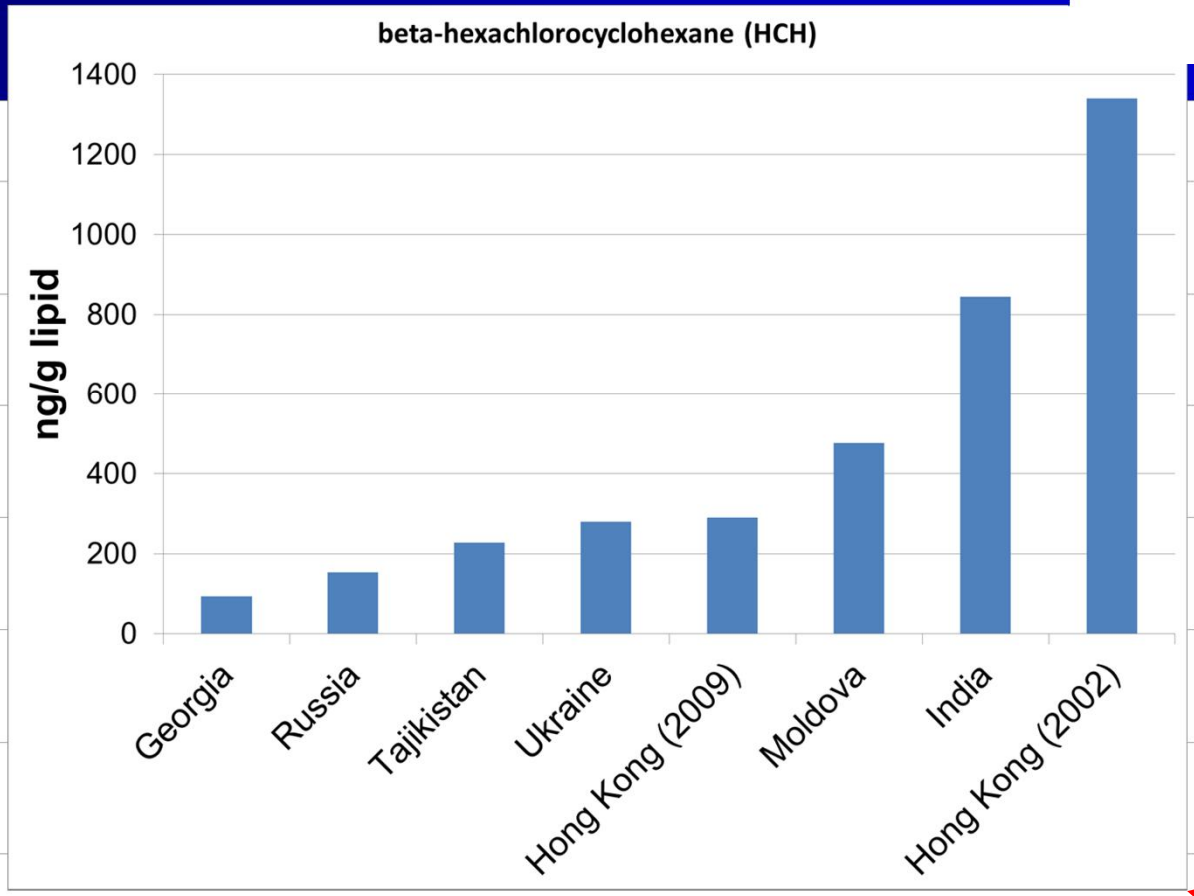


- ✓ **Gamma-HCH** (14 – 15 %)



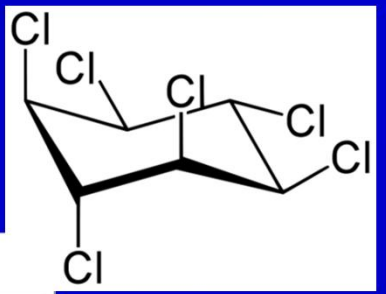
Beta-HCH


Cl
Cl
Cl
Cl
Cl
Cl


beta-hexachlorocyclohexane (HCH)
ng/g lipid
1400
1200
1000
800
600
400
200
0
Georgia
Russia
Tajikistan
Ukraine
Hong Kong (2009)
Moldova
India
Hong Kong (2002)

ng/g lipid
1400
1200
1000
800
600
400
200
0
Haiti (2005)
Haiti (2011)
Chile (2011)
Ethiopia (2013)
Tonga (2008)
Jamaica (2011)
Togo (2010)
Tuvalu (2011)
Samoa (2011)
Fiji / Kadavu (2011)
Mexico (2011)
Fiji (2011)
Congo (Dem.Rep.) (2009)
Niue (2011)
Marshall Islands (2011)
Fiji (2006)
Kenya (2009)
Palau (2011)
Uganda (2009)
Ghana (2009)
Indonesia (2011)
Finland (2001)
Antigua and Barbuda (2009)
Switzerland (2009)
Kiribati (2011)
Pacific States (2011)
Solomon Islands (2011)
Barbados (2010)
Fiji (2002)
Norway (2006)
New Zealand (2011)
Kiribati (2006)
Cuba (2011)
Chile (2009)
Sweden (2007)
Djibouti (2011)
Niger (2012)
Philippines (2002)
Slovak Rep. (2006)
Belgium (2010)
Norway (2001)
Israel (2012)
Australia (2010)
Cote d'Ivoire (2010)
Belgium (2006)
USA (2003)
Lithuania (2009)
Ireland (2010)
Luxembourg (2006)
Hungary (2006)
Germany (2002)
Korea (Rep. of) (2009)
Czech Rep. (2006)
Mauritius (2009)
Cyprus (2006)
Peru (2011)
Luxembourg (2002)
Ireland (2002)
Brazil (2002)
Mali (2009)
Czech Rep. (2001)
Syria (2009)
Nigeria (2009)
Uruguay (2009)
Sudan (2006)
Senegal (2009)
Egypt (2002)
Bulgaria (2001)
Italy (2001)
Spain (2002)
Georgia (2009)
Russia (2002)
Tajikistan (2009)
Ukraine (2001)
Hong Kong SAR (2009)
Moldova (2009)
India (2009)
Hong Kong SAR (2002)

Gamma-HCH


Cl
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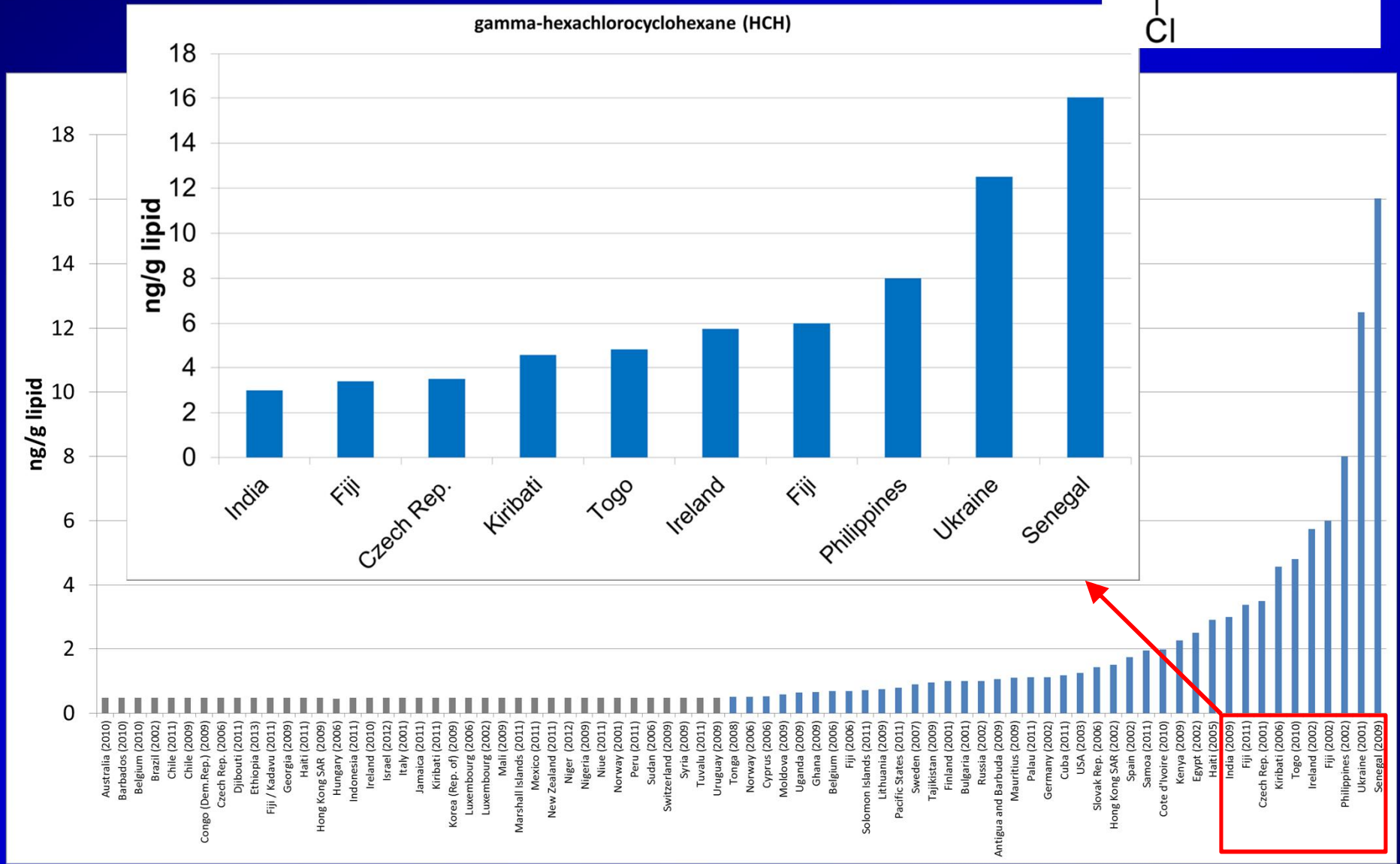
Cl
Cl


gamma-hexachlorocyclohexane (HCH)
ng/g lipid
0
2
4
6
8
10
12
14
16
18
India
Fiji
Czech Rep.
Kiribati
Togo
Ireland
Fiji
Philippines
Ukraine
Senegal
ng/g lipid
Australia (2010)
Barbados (2010)
Belgium (2010)
Brazil (2002)
Chile (2011)
Chile (2009)
Congo (Dem.Rep.) (2009)
Czech Rep. (2006)
Djibouti (2011)
Ethiopia (2013)
Fiji / Kadavu (2011)
Georgia (2009)
Haiti (2011)
Hong Kong SAR (2009)
Hungary (2006)
Indonesia (2011)
Ireland (2010)
Israel (2012)
Italy (2001)
Jamaica (2011)
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Korea (Rep. of) (2009)
Luxembourg (2006)
Luxembourg (2002)
Mali (2009)
Marshall Islands (2011)
Mexico (2011)
New Zealand (2011)
Niger (2012)
Nigeria (2009)
Niue (2011)
Norway (2001)
Peru (2011)
Sudan (2006)
Switzerland (2009)
Syria (2009)
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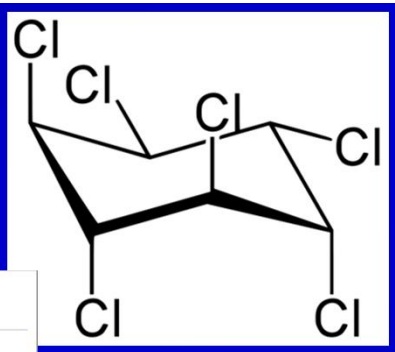
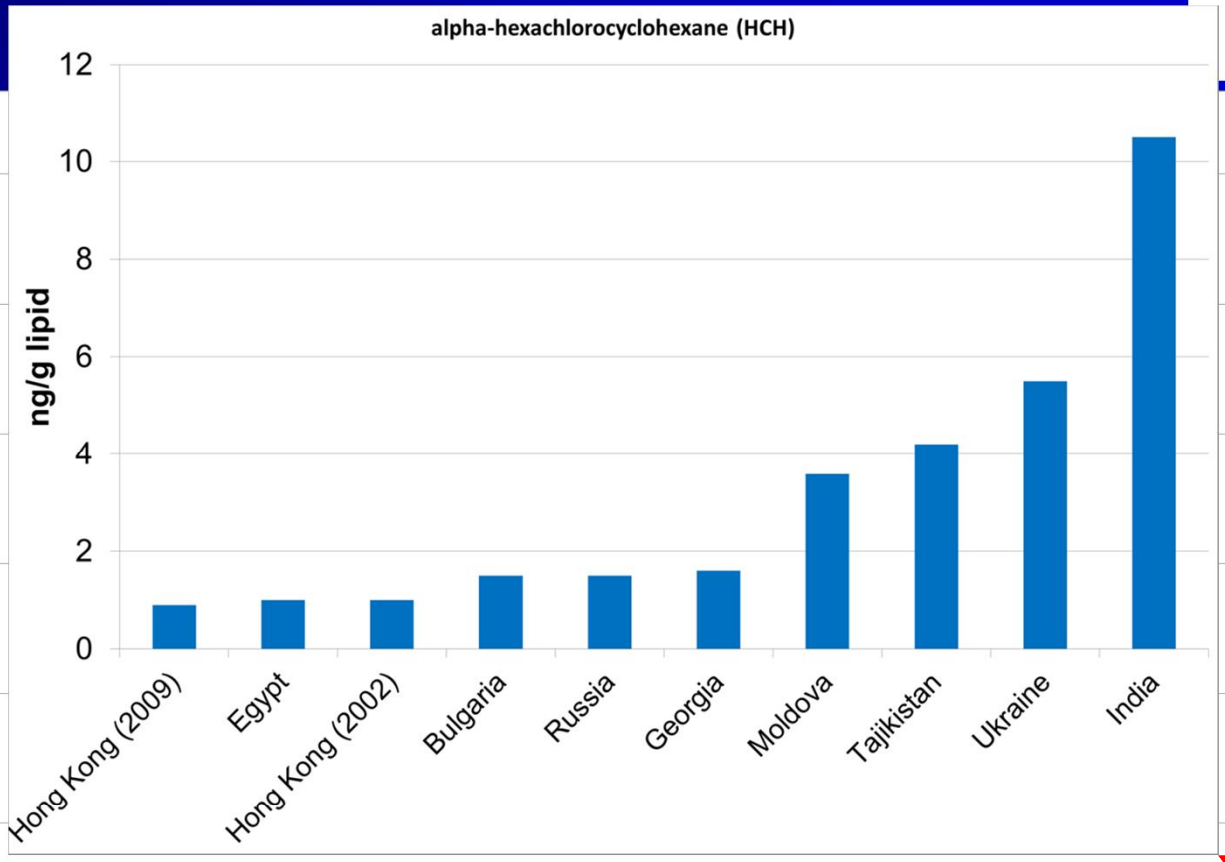
Uruguay (2009)
Tonga (2008)
Norway (2006)
Cyprus (2006)
Moldova (2009)
Uganda (2009)
Ghana (2009)
Belgium (2006)
Fiji (2006)
Solomon Islands (2011)
Lithuania (2009)
Pacific States (2011)
Sweden (2007)
Tajikistan (2009)
Finland (2001)
Bulgaria (2001)
Russia (2002)
Antigua and Barbuda (2009)
Mauritius (2009)
Palau (2011)
Germany (2002)
Cuba (2011)
USA (2003)
Slovak Rep. (2006)
Hong Kong SAR (2002)
Spain (2002)
Samoa (2011)
Cote d'Ivoire (2010)
Kenya (2009)
Egypt (2002)
Haiti (2005)
India (2009)
Fiji (2011)
Czech Rep. (2001)
Kiribati (2006)
Togo (2010)
Ireland (2002)
Fiji (2002)
Philippines (2002)
Ukraine (2001)
Senegal (2009)

Alpha-HCH


Cl
Cl
Cl
Cl
Cl
Cl


alpha-hexachlorocyclohexane (HCH)
ng/g lipid
0
2
4
6
8
10
12
Hong Kong (2009)
Egypt
Hong Kong (2002)
Bulgaria
Russia
Georgia
Moldova
Tajikistan
Ukraine
India

ng/g lipid
0
2
4
6
8
10
12
Antigua and Barbuda (2009)
Australia (2010)
Barbados (2010)
Belgium (2010)
Belgium (2006)
Brazil (2002)
Chile (2011)
Chile (2009)
Congo (Dem.Rep.) (2009)
Cote d'Ivoire (2010)
Cuba (2011)
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Czech Rep. (2001)
Djibouti (2011)
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Fiji (2011)
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Fiji / Kadavu (2011)
Finland (2001)
Germany (2002)
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Niger (2012)
Nigeria (2009)
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Norway (2006)
Norway (2001)
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Philippines (2002)
Samoa (2011)
Senegal (2009)
Slovak Rep. (2006)
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Sweden (2007)
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Syria (2009)
Togo (2010)
Tonga (2008)
Tuvalu (2011)
Uganda (2009)
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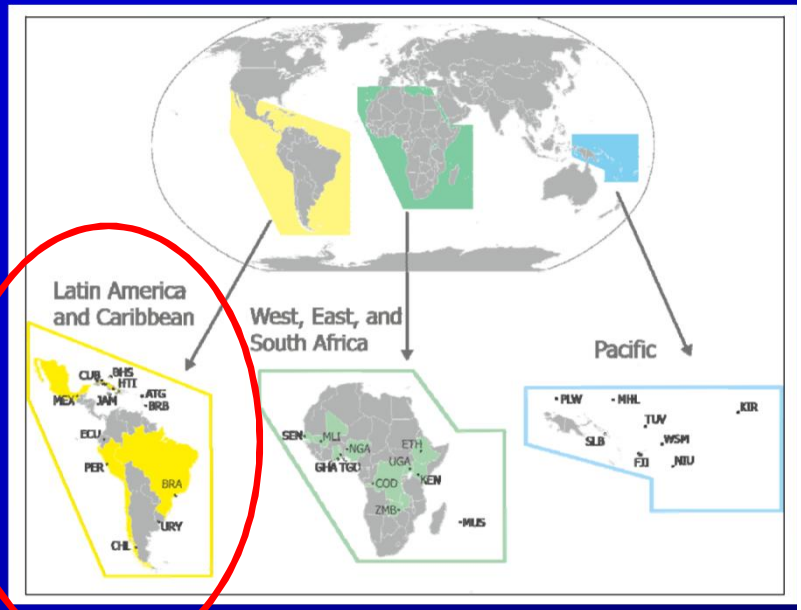
USA (2003)
Hong Kong SAR (2009)
Egypt (2002)
Hong Kong SAR (2002)
Bulgaria (2001)
Russia (2002)
Georgia (2009)
Moldova (2009)
Tajikistan (2009)
Ukraine (2001)
India (2009)

HCH in air

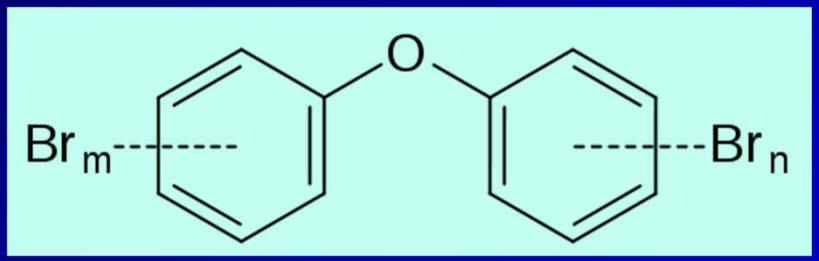
Contribution (%) to „Sum HCHs“ in air of Latin America and Caribbean *):

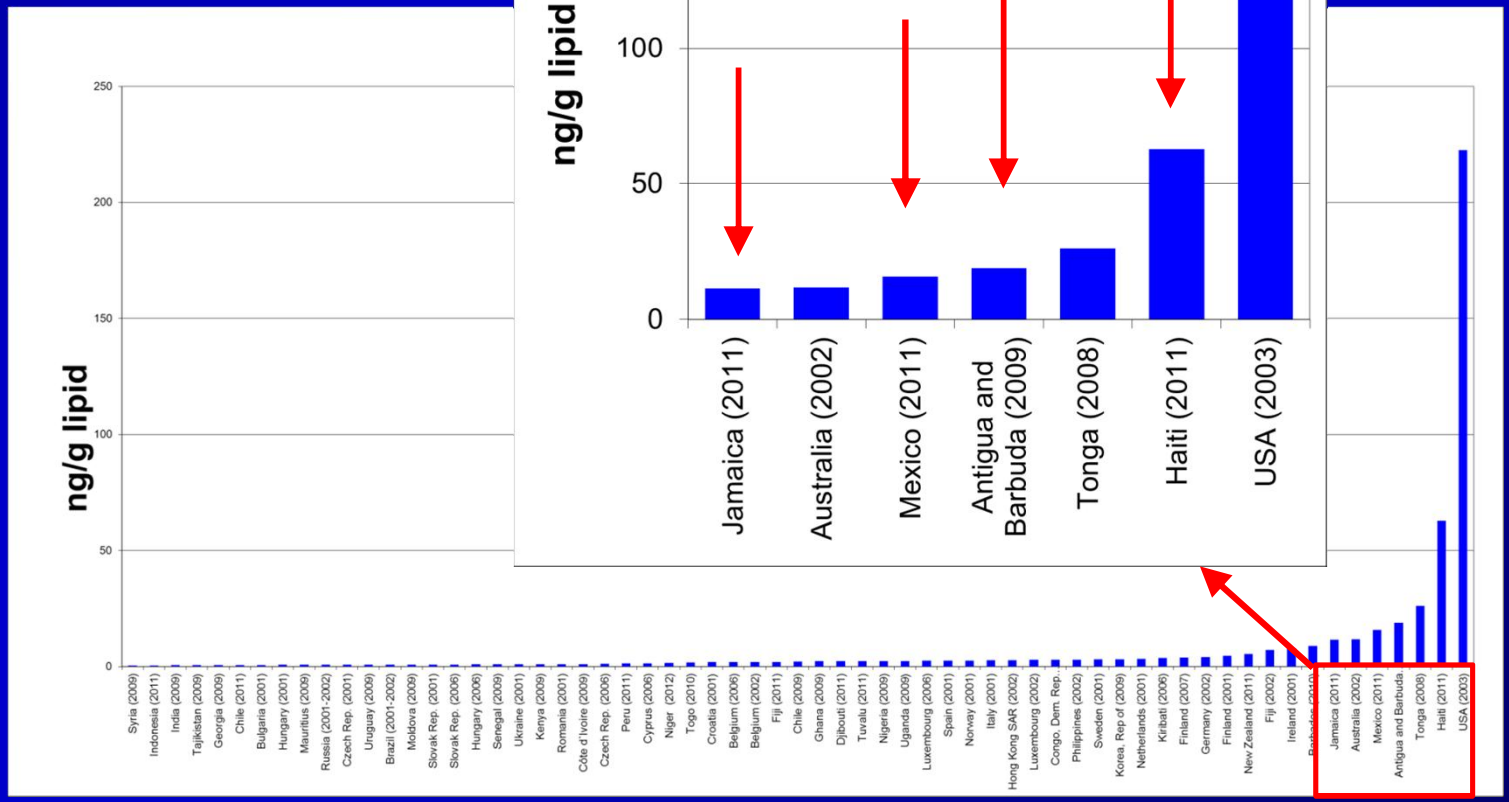
	%
Alpha-HCH	41
Beta-HCH	2
Gamma-HCH	56



*) calculated on basis of median for all samples

Sum PBDE

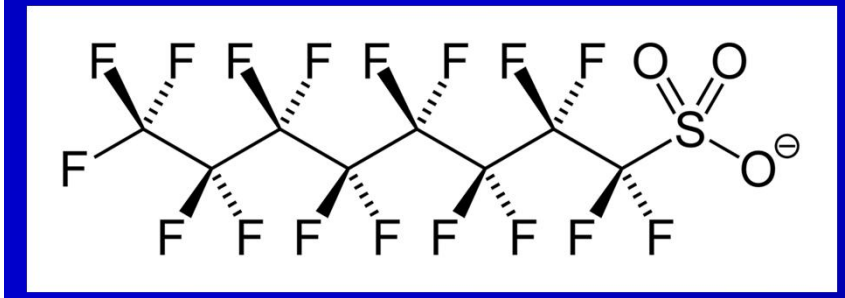




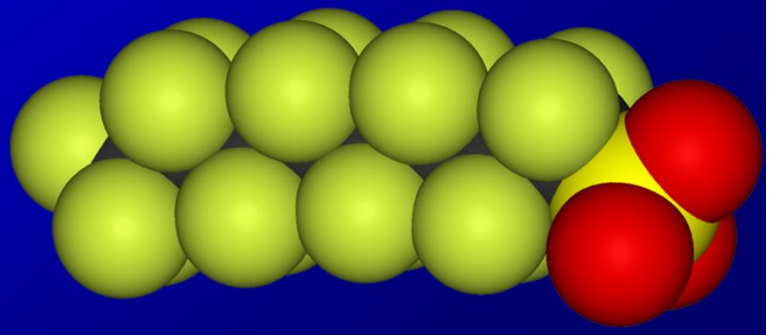
No increase of PBDD/F-levels with increasing PBDE levels

Perfluorinated compounds (PFCs)

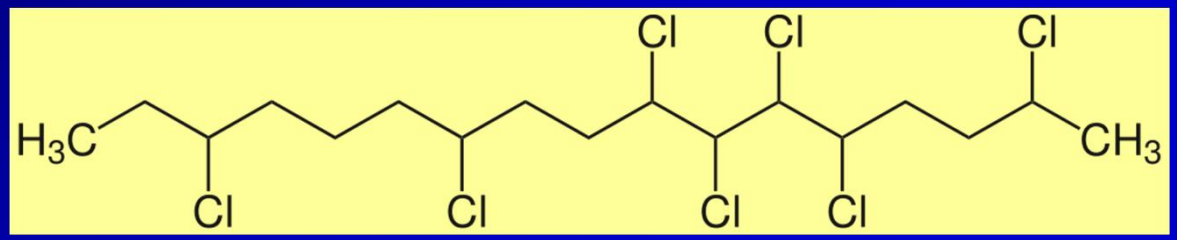
- Lack of lipophilicity results in relatively low levels in milk compared to serum/blood (distribution milk/serum ~1:100).
- Distribution varies for different PFCs.
- More reliable data would be generated using blood/serum.



PFOS

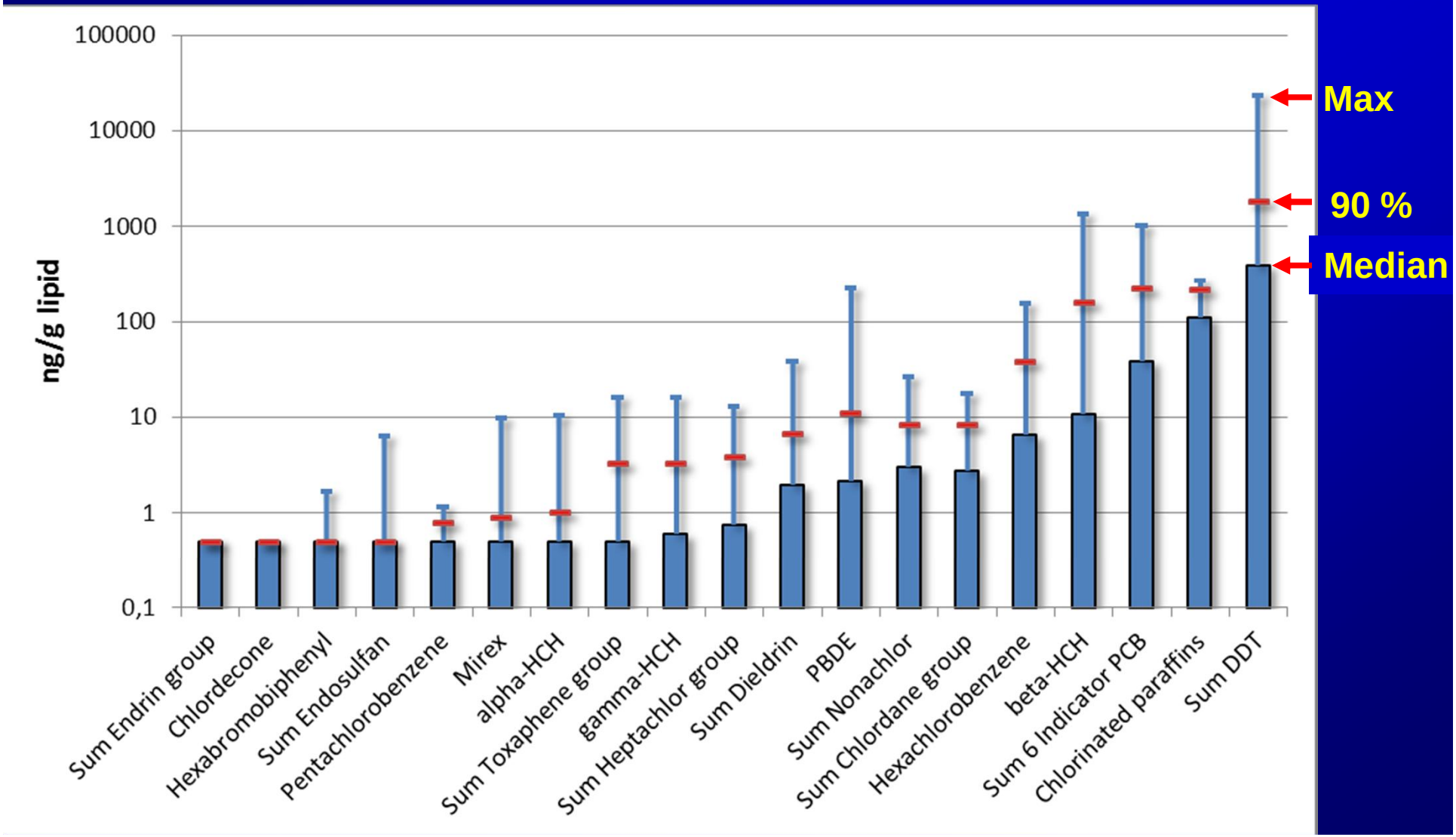


Chlorinated Paraffins (CPs)

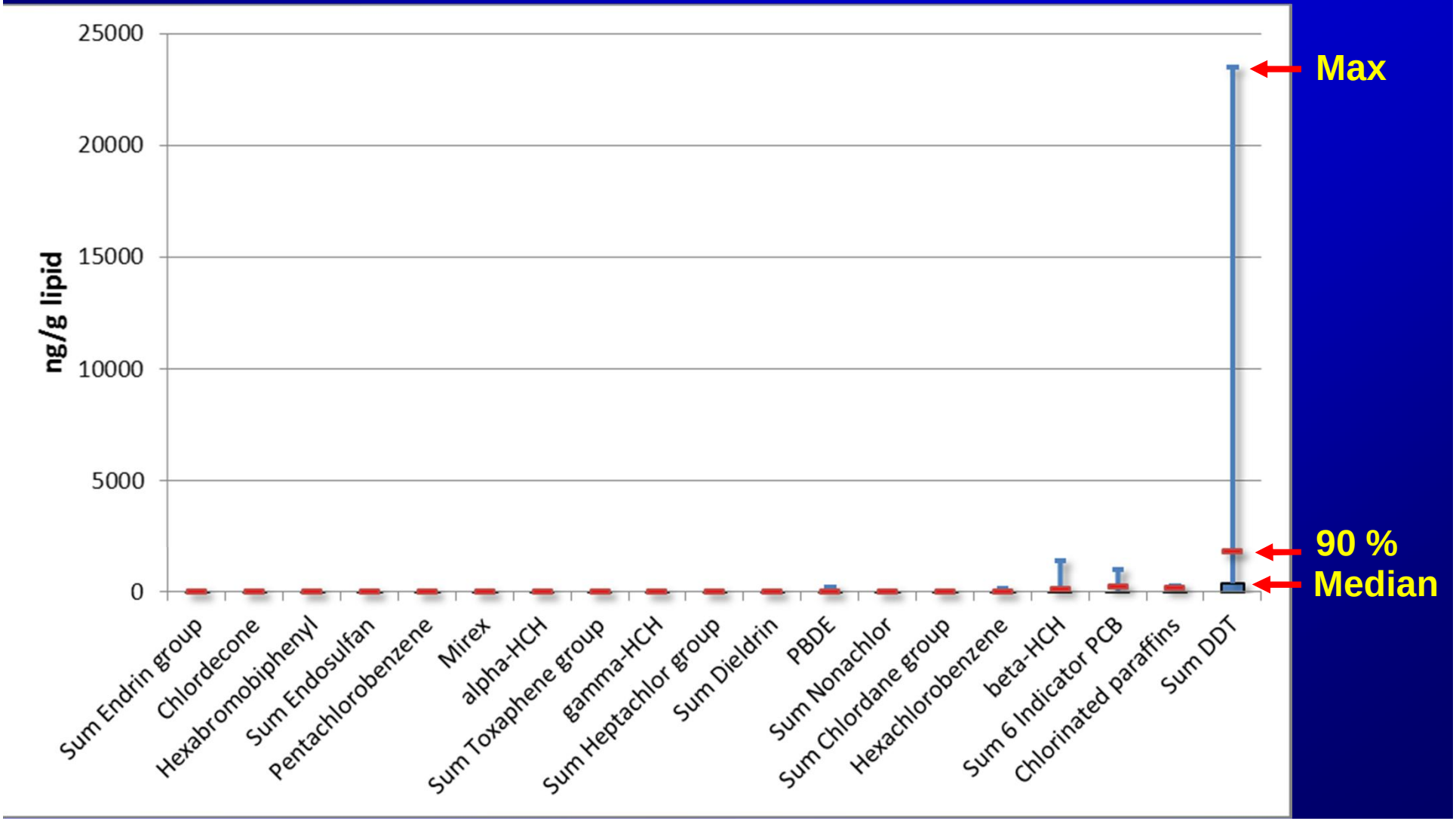


- ✓ general formula CnH2n+2-zClz
- ✓ variation of chain length, number and position of chlorines
  - ➢ **short chain CPs (SCCP; C10 – C13)**
  - ➢ **medium chain CPs (MCCP; C14 – C17)**
  - ➢ **long chain CPs (LCCP; > C17)**
- ✓ **complex mixtures: > 10.000 compounds**
- ✓ **chlorine content of commercially available mixtures between 30 – 70 %**

Stockholm Convention POPs in breast milk
(ng/g lipid)

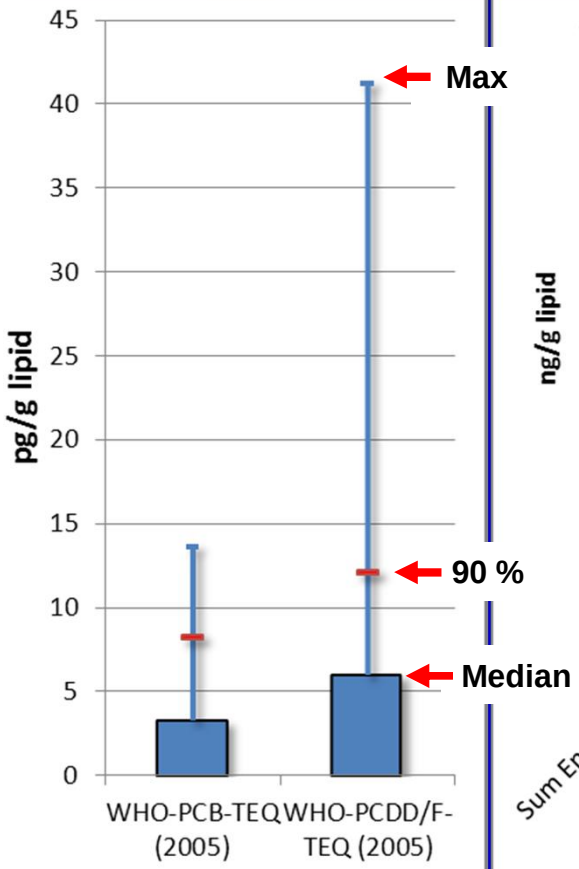


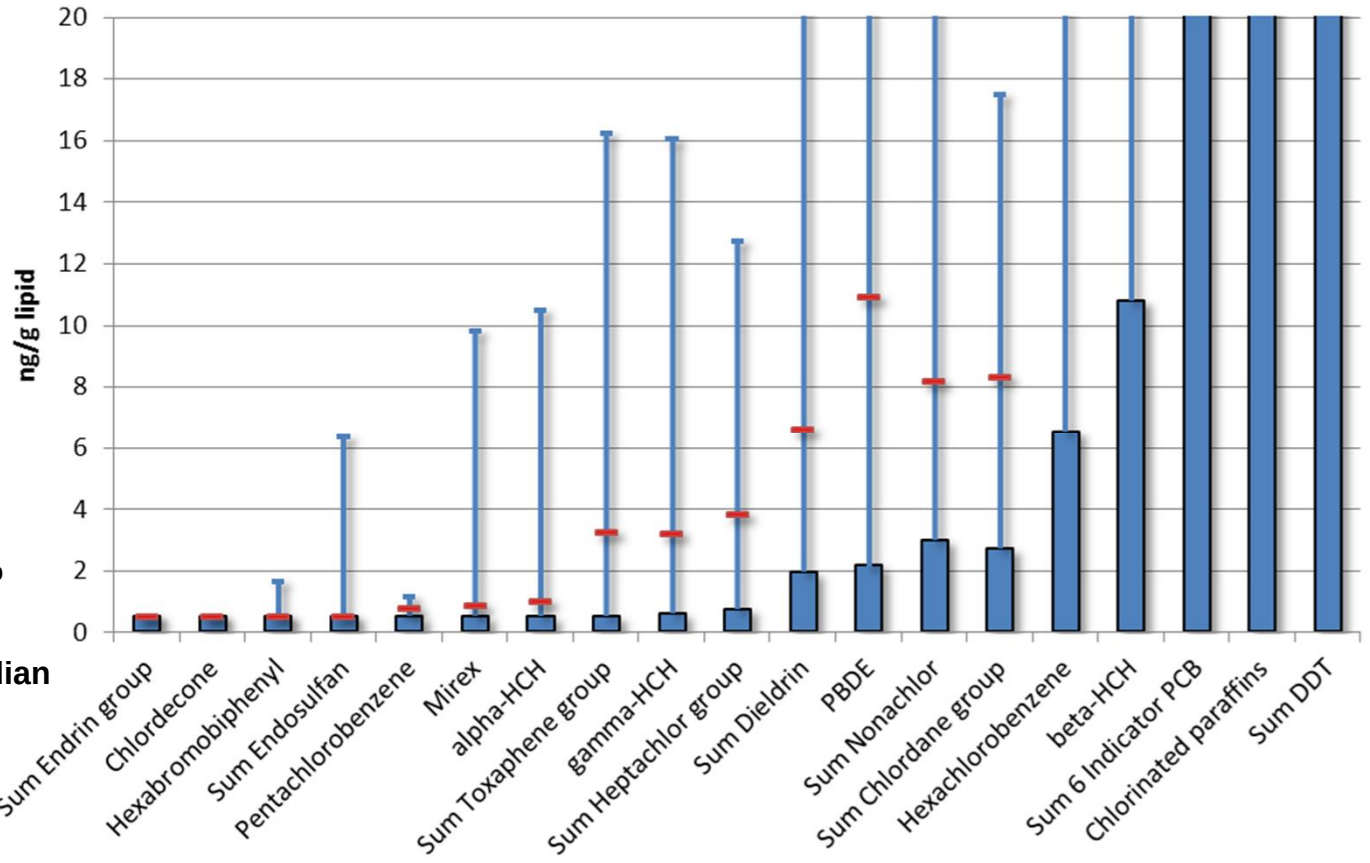
Stockholm Convention POPs in breast milk
(ng/g lipid)



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 month**

Risk evaluation of breast feeding

with regard to concentrations of

PCDDs, PCDFs, PCBs and DDTs

Arch Toxicol
DOI 10.1007/s00204-016-1802-z

REVIEW ARTICLE

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

Martin van den Berg[1] · Karin Kypke[2] · Alexander Kotz[2] · Angelika Tritscher[3] · Seoung Yong Lee[3] · Katarina Magulova[4] · Heidelore Fiedler[5] · Rainer Malisch[2]

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 dosis (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 dosis (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

	unit	safety standards as "Equivalent milk level"	Ranges in human milk (pooled samples)						
			Min	25th perc.	Median	75th perc.	90th perc.	95th perc.	Max
WHO-PCDD/F-PCB-TEQ (2005 / UB)	pg/g lipid	0.2 – 0.9	1,5	5,6	9,4	14,3	20,3	23,7	49,0
Total PCBs *)	ng/g lipid	7	2	18	38	121	223	347	1009
Sum DDT **)	ng/g lipid	2300	23	171	396	1015	1849	2616	23472

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

Risk-benefit assessment for PCDDs, PCDFs, PCBs and DDTs

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.

Risk-benefit assessment for PCDDs, PCDFs, PCBs and DDTs

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 !