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Contamination of chicken eggs near the Queen Mary's Hospital, Lucknow medical waste incinerator in Uttar Pradesh (India) by dioxins, PCBs and hexachlorobenzene

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“Keep the Promise, Eliminate POPs!” Campaign Report

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Executive Summary

Free-range chicken eggs collected near the Queen Mary's Hospital, Lucknow medical waste incinerator in Uttar Pradesh (India) showed high levels of dioxins and PCBs. Dioxin levels exceeded background levels by more than 16-fold and were five and half times higher than the European Union (EU) dioxin limit for eggs. Levels of PCBs exceeded proposed regulatory limits by 4.7-fold. To our knowledge, this study represents the first data about POPs in chicken eggs from India.

The toxic substances measured in this study are slated for reduction and elimination by the Stockholm Convention which holds its first Conference of the Parties beginning 2 May 2005. India signed the Convention in 2002 but has not ratified it. The Convention mandates Parties to take specific actions aimed at eliminating these pollutants from the global environment. We view the Convention text as a promise to take the actions needed to protect Indian and global public’s health and environment from the injuries that are caused by persistent organic pollutants, a promise that was agreed by representatives of the global community: governments, interested stakeholders, and representatives of civil society. We call upon Indian governmental representatives and all stakeholders to pursue ratification of this important Treaty, honor the integrity of the Convention text and keep the promise of reduction and elimination of POPs.

Recommendations

1) More POPs monitoring in India is needed;

2) More publicly accessible data about U-POPs releases from all potential sources in the region are needed to address them properly; data given by the UNEP Toolkit are not satisfactory;

3) Stringent limits for U-POPs releases and levels in waste should be introduced into both national legislation and Stockholm Convention follow up documents.

4) PVC-containing waste should not be burned and preferably other materials that do not contain chlorine should be substituted for products currently using PVC, especially in health care.

5) India should ratify Stockholm Convention.

Introduction

Persistent organic pollutants (POPs) harm human health and the environment. POPs are produced and released to the environment predominantly as a result of human activity. They are long lasting and can travel great distances on air and water currents. Some POPs are produced for use as pesticides, some for use as industrial chemicals, and others as unwanted byproducts of combustion or chemical processes that take place in the presence of chlorine compounds. Today, POPs are widely present as contaminants in the environment and food in all regions of the world. Humans everywhere carry a POPs body burden that contributes to disease and health problems.

The international community has responded to the POPs threat by adopting the Stockholm Convention in May 2001. The Convention entered into force in May 2004 and the first Conference of the Parties (COP1) will take place on 2 May 2005. India signed the Convention in May 2002.

The Stockholm Convention is intended to protect human health and the environment by reducing and eliminating POPs, starting with an initial list of twelve of the most notorious, the "dirty dozen." Among this list of POPs there are four substances that are produced unintentionally (U-POPs): polychlorinated biphenyls (PCBs), hexachlorobenzene (HCB), polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs) The last two groups are simply known as dioxins.

The International POPs Elimination Network (IPEN) asked whether free-range chicken eggs might contain U-POPs if collected near potential sources of U-POPs named by the Stockholm Convention. The neighborhood of the Queen Mary's Hospital, Lucknow medical waste incinerator in Uttar Pradesh (India) was selected as a sampling site since medical waste incinerators are known to produce dioxins and furans as well as hexachlorobenzene and PCBs. Chicken eggs were chosen for several reasons: they are a common food item; their fat content makes them appropriate for monitoring chemicals such as POPs that dissolve in fat; and eggs are a powerful symbol of new life. Free range hens can easily access and eat soil animals and therefore their eggs are a good tool for biomonitoring of environmental contamination by U-POPs. This study is part of a global monitoring of egg samples for U-POPs conducted by IPEN and reflects the first data about U-POPs in eggs ever reported in India.

Materials and Methods

Please see Annex 1.

Results and Discussion

U-POPs in eggs sampled near the Queen Mary's Hospital, Lucknow medical waste incinerator in Uttar Pradesh (India)

The results of the analysis of a pooled sample of 4 eggs collected near the Queen Mary's Hospital, Lucknow medical waste incinerator in Uttar Pradesh (India) are summarized in Tables 1 and 2. Pooled sample fat content was measured at 12.5%.

Levels of dioxins found in sampled eggs from the Lucknow in Table 1 were five and half times higher than the EU dioxin limit for eggs. In addition, the samples exceeded the proposed limits for PCBs (in WHO-TEQs) by 4.7-fold.

Table 1: Measured levels of POPs in eggs collected near the Queen Mary's Hospital, Lucknow medical waste incinerator in Uttar Pradesh (India) per gram of fat.

	Measured level	Limits	Action level
PCDD/Fs in WHO-TEQ (pg/g)	19.80	3.0[a]	2.0[b]
PCBs in WHO-TEQ (pg/g)	9.40	2.0[b]	1.5[b]
Total WHO-TEQ (pg/g)	29.20	5.0[b]	-
PCB (7 congeners) (ng/g)	75.34	200[c]	-
HCB (ng/g)	3.80	200 (10)[d]	-

Abbreviations: WHO, World Health Organization; TEQ, toxic equivalents; pg, pictogram; g, gram; ng, nanogram.

[a] Limit set up in The European Union (EU) Council Regulation 2375/2001 established this threshold limit value for eggs and egg products. There is even more strict limit at level of 2.0 pg WHO-TEQ/g of fat for feedingstuff according to S.I. No. 363 of 2002 European Communities (Feedingstuffs) (Tolerances of Undesirable Substances and Products) (Amendment) Regulations, 2002.

[b] These proposed new limits are discussed in the document Presence of dioxins, furans and dioxin-like PCBs in food. SANCO/0072/2004.

[c] Limit used for example in the Czech Republic according to the law No. 53/2002 as well as in Poland and/or Turkey.

[d] EU limit according to Council Directive 86/363/EEC, level in brackets is proposed new general limit for pesticides residues (under which HCB is listed) according to the Proposal for a Regulation of the European Parliament and of the Council on maximum residue levels of pesticides in products of plant and animal origin, COM/2003/0117 final - COD 2003/0052.

Table 2 shows that the level of dioxins in eggs expressed as fresh weight exceeded the limit for commercial eggs in the USA by 1.5 fold. The US Food and Drug Administration estimates a lifetime excess cancer risk of one in 10,000 for eggs contaminated at 1 pg/g ITEQ. The samples collected near the Queen Mary's Hospital, Lucknow medical waste incinerator in Uttar Pradesh (India) exceeded this cancer risk level.[a]

Table 2: Measured levels of POPs in eggs collected near the Queen Mary's Hospital, Lucknow medical waste incinerator in Uttar Pradesh (India) per gram of egg fresh weight.

	Measured level	Limits	Action level
PCDD/Fs in WHO-TEQ (pg/g)	2.48	1[a]	-
PCBs in WHO-TEQ (pg/g)	1.18	-	-
Total WHO-TEQ (pg/g)	3.65	-	-
PCBs (7 congeners) (ng/g)	9.42		
HCB (ng/g)	0.48	-	-

Abbreviations: WHO, World Health Organization; TEQ, toxic equivalents; pg, pictogram; g, gram; ng, nanogram.

[a] U.S. Department of Agriculture Food Safety and Inspection Service [Memo 8 July 1997] Advisory to Owners and Custodians of Poultry, Livestock and Eggs. Washington, DC:U.S. Department of Agriculture, 1997. FSIS advised in this memo meat, poultry and egg product producers that products containing dioxins at levels of 1.0 ppt in I-TEQs or greater were adulterated. There is an even more strict EU limit at level of 0.75 pg WHO-TEQ/g of eggs fresh weight for feeding stuff according to S.I. No. 363 of 2002 European Communities (Feedingstuffs) (Tolerances of Undesirable Substances and Products) (Amendment) Regulations, 2002.

To our knowledge, the measurements of U-POPs in this study represent the first data on U-POPs in chicken eggs ever reported in India. The surprisingly high-levels of U-POPs observed in the egg

[a] was estimated (using a cancer potency factor of 130 (mg/kg-day)-1 and rounding the risk to an order of magnitude) for consumption of 3-4 eggs per week (30 g egg/day) contaminated at 1 ppt ITEQ[a, a]

samples support the need for further monitoring and longer-term changes to prevent medical waste incineration as a common source of dioxins as well as other U-POPs.

Comparison with other studies of eggs

The dioxin levels in eggs in this study exceed background levels by more than 16-fold (0.2 - 1.2 pg WHO-TEQ/g of fat).

We compared the levels of PCDD/Fs measured in this study in eggs from the neighborhood of the Queen Mary's Hospital, Lucknow medical waste incinerator in Uttar Pradesh (India) with data from other studies that also used pooled samples and/or expressed mean values of analyzed eggs (Please see Annexes 2 and 3.) The data for eggs described in this report follow on the heels of similar studies in Slovakia released 21 March 2005[1], Kenya[2], Czech Republic[3] and Belarus[4]. Dioxin levels in the eggs sampled from the Lucknow city in Uttar Pradesh (India) were almost five times higher than those observed in eggs collected in Belarus (dumpsite Bolshoi Trostenec) and the Czech Republic (near chemical plant) and almost two-fold higher than those observed in eggs collected in Slovakian villages downwind of the Koshice municipal waste incinerator. There were slightly lower levels of dioxins comparing to eggs collected at the Dandora dumpsite in Kenya.

Other studies showing high levels of dioxins include samples near an old waste incinerator in Maincy, France [5] and an area affected by a spread mixture of waste incineration residues in Newcastle, UK.[6] The mean dioxin values observed in these locations in pooled samples were even higher than the values observed in this study at 42.47 pg WHO-TEQ/g and 31 pg WHO-TEQ/g respectively.

It is clear that dioxins represent the most serious contaminant in the sampled eggs from the Lucknow city. PCDD/Fs contribute almost 75% of the whole TEQ value in eggs as visible from graph in Annex 5. Despite this substantial contribution of dioxins, levels of PCBs and HCB are not negligible as shown in Annex 4 for PCBs and in Annex 6 for HCB. PCBs levels expressed in WHO-TEQs are lower than those found in Lysa nad Labem from Czech Republic,[7] and in Bolshoi Trostenec from Belarus[8] but higher than for example levels found in Kenya,[9] Uzbekistan[10] and/or in Dutch organic farms.[11]

Possible U-POPs sources

The high levels of U-POPs in free range chicken eggs in these samples provoke the question of possible sources. There are several potential sources of dioxins within the Lucknow vicinity.

There are six medical waste incinerators operational in the city of Lucknow including the Queen Mary's Hospital, Lucknow medical waste incinerator.

Others are as follow:

1. Nagar Nigam biomedical waste incinerator where the waste is collected from ten private and two government hospitals in the city.
2. Balrampur Hospital receives waste from eighteen hospitals in the city as well as the in-house waste generated in the hospital.
3. Fatima Hospital caters to the waste generated in-house only which is incinerated.
4. At Sanjay Gandhi Post Graduate Institute of Medical Research (SGPGI) the waste generated in-house only is incinerated.
5. Earaz Medical College receives in-house waste only.

The Pesticides Factory is located near about 25 km from the city station in the Chinhat Industrial Area. Near the organochlorine pesticides manufacturing unit, the brick kilns and the ceramic and pottery-manufacturing units also have combustion of coal and wood charcoal which may also be a potential sources of dioxins mainly in case of waste co-burning. In addition, there are small scale PVC recycling units operational in the city that manufacture PVC pipes from used articles like shoe soles, flooring, upholstery, wall coverings, electrical insulations and toys. The PVC recycling unit operates in congested residential areas without any license from the Pollution Control Board. The air within and outside the factory premises is foul smelling and the smoke released from the industry blackens the nearby buildings.

The paper and pulp industry located on the outskirts of the city may also be a potential source since dioxins are liberated during bleaching of paper with chlorine gas. Besides hazardous waste landfills containing all sorts of plastics are often subjected to open air burning that may also generate dioxins. In addition, some possible open burning can be considered as potential U-POPs sources in both villages. Most households in the village do not use brown coal and/or wood burning for heating, but we consider them as potential sources of U-POPs.

Tracking the source of dioxins in eggs can be aided by comparing the pattern of congeners in the samples with those in the sources. Unfortunately, dioxin air emissions from all potential sources measurements are not available for the comparison. However, congener patterns for these sources are available even from the neighboring countries. Therefore we tried to compare eggs and medical waste incinerator with more sophisticated air pollution control device (APC) pattern from the Czech Republic. This comparison is shown in the graph in Annex 7.

The congener pattern observed in this study is dominated by 1,2,3,7,8 PeCDD, 2,3,4,7,8 PeCDF and 2,3,7,8 TeCDD. In first two mentioned dominant congeners it follows the Czech medical waste incinerator pattern. Even though there is basic agreement with the medical waste incinerator pattern, some other sources of dioxins probably contribute to dioxins found in eggs from Lucknow. But it is necessary to stress that an Indian medical waste incinerator can have a different pattern of dioxin congeners. On the other hand, the medical waste incinerator in the Queen Mary's Hospital is the nearest significant larger source of dioxins to the sampling site.

This pooled six-sample supports calls for a larger monitoring study which would be focused on all U-POPs levels in homegrown food in the area.

The Medical Waste Incinerator in the Queen Mary's Hospital

The Medical Waste Incinerator is located within the premises of Queen Mary's Hospital. The hospital is located in the close vicinity of 'Chowk' market and within 5 km from the main Charbagh Railway Station. The incinerator was installed in the hospital in 1999. The incinerator receives approximately 105 kg of bio medical waste per day on an average from five nearby hospitals: King Georges Medical University; Trauma and Emergency Centers (Three); and Dental University. The incinerator operates for five hours per day.

The incinerator has a primary chamber, secondary chamber and a scrubbing chamber and a filtering chamber. The fly ash is piled up and collected near the incinerator before being finally dumped into the municipal drains. The leachate from the scrubbing chamber of the incinerator is also allowed to flow into the municipal drains.

The temperature in the incinerator is regulated by a thermostat to a combustion range of 500- 650^{O} C. The entire incinerator compound and also the area where the fly ash is dumped is frequented by stray animals like pigs, dogs, cats and birds. The incinerator staff does not wear any protective clothing or gloves. The waste from the hospitals is transported to the incinerator by open cycle rickshaw trolleys. A record of the amount of waste received per day is also maintained.

Since the hospital lies in the old city area the residential localities near the hospital are highly congested. Just outside the premises of the incinerator complex is the main road and adjacent to on the east side boundary there is a highly populated slum locality The slum area is inhabited by the sanitation staff i.e the sweepers and cleaners of the hospital. The resident apartments of the doctors and nurses are also located just adjacent to the incinerator chimney.

Although the bio medical waste from the hospitals is brought to the incinerator regularly, the sanitation staff at the nearby King Georges Medical University revealed the practice of open burning of biomedical waste in the backyard.

U-POPs and the Stockholm Convention

The U-POPs measured in this study are slated for reduction and elimination by the Stockholm Convention which holds its first Conference of the Parties in May 2005. India signed the Convention in 2002 but has not ratified it.

The Convention mandates Parties to take specific actions aimed at eliminating these pollutants from the global environment. Parties are to require the use of substitute or modified materials, products and processes to prevent the formation and release of U-POPs.[b] Parties are also required to promote the use of best available techniques (BAT) for new facilities or for substantially modified facilities in certain source categories (especially those identified in Part II of Annex C).[c] In addition, Parties are to promote both BAT and best environmental practices (BEP) for all new and existing significant source categories,[d] with special emphasis on those identified in Parts II and III. As part of its national implementation plan (NIP), each Party is required to prepare an inventory of its significant sources of U-POPs, including release estimates.[e] These NIP inventories will, in part, define activities for countries that will be eligible for international aid to implement their NIP. Therefore it is important that the inventory guidelines are accurate and not misleading.

The Stockholm Convention on POPs is historic. It is the first global, legally binding instrument whose aim is to protect human health and the environment by controlling production, use and disposal of toxic chemicals. We view the Convention text as a promise to take the actions needed to protect Indian and global public’s health and environment from the injuries that are caused by persistent organic pollutants, a promise that was agreed by representatives of the global community: governments, interested stakeholders, and representatives of civil society. We call upon Indian governmental representatives and all stakeholders to honor the integrity of the Convention text and keep the promise of reduction and elimination of POPs.

[b] Article 5, paragraph (c)
[c] Article 5, paragraph (d)
[d] Article 5, paragraphs (d) & (e)
[e] Article 5, paragraph (a), subparagraph (i)

Annex 1. Materials and Methods

Sampling

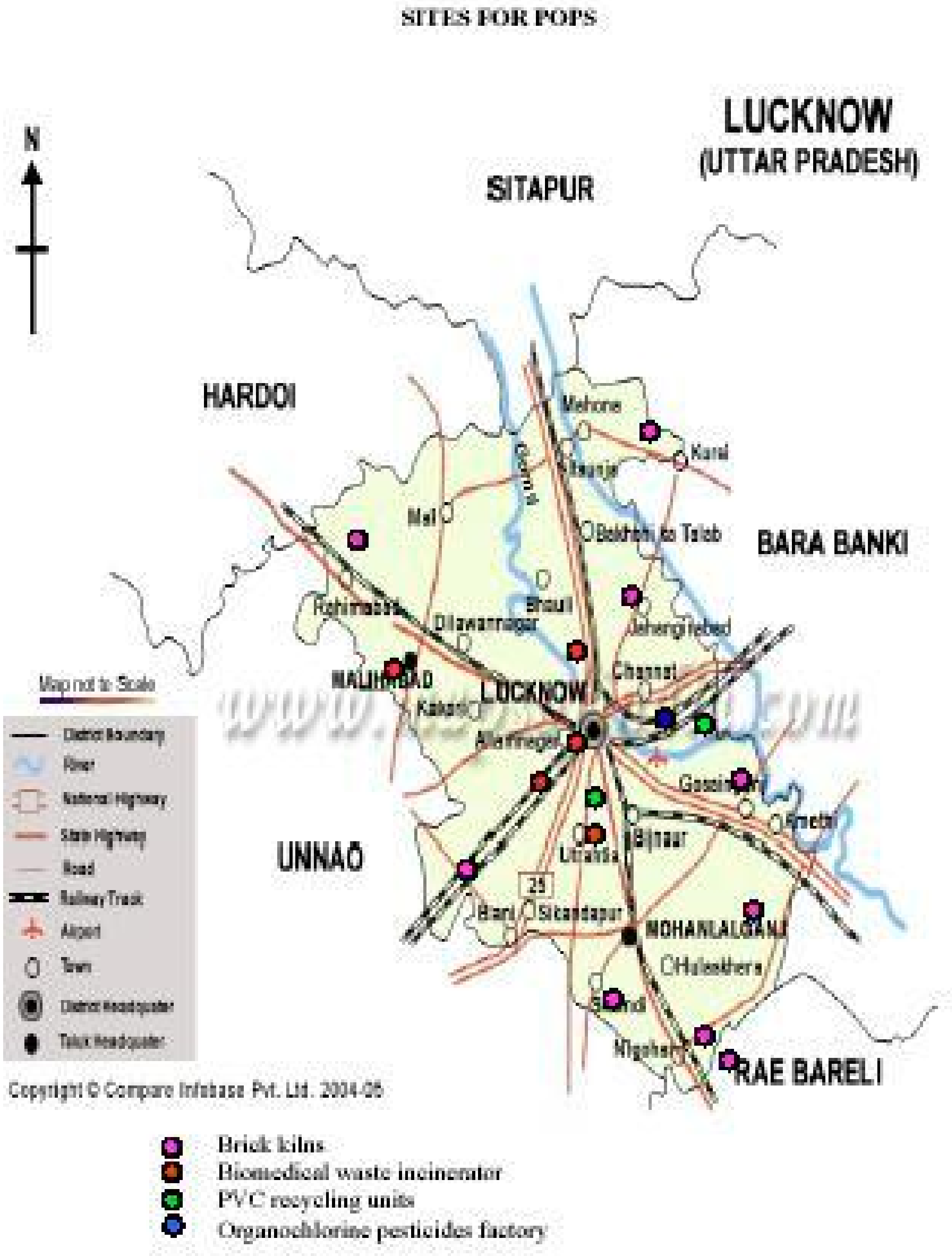
For sampling in central India we have chosen neighborhood of the medical waste incinerator in Queen Mary's Hospital located in the center of the City of Lucknow in Uttar Pradesh. The eggs were collected from one chicken fancier in 0.5 km distance from the incinerator. The hens from which the eggs were picked were between 1 and 1.5 year old, and were all free-range although occasionally provided with grain available at home. The hens can easily access soil organisms and freely roam over an area of 100 square meters.

Sampling was done by members of Toxics Link on 30 January 2005. One chicken fancier supplied 10 eggs from his free range chickens. The eggs were kept in cool conditions after sampling and then were boiled in India by Toxics Link for 7 - 10 minutes in pure water and transported by express service to the laboratory at ambient temperature.

Analysis

After being received by the laboratory, the eggs were kept frozen until analysis. The egg shells were removed and the edible contents of 4 eggs were homogenised. A 30 g sub-sample was dried with anhydrous sodium sulphate, spiked by internal standards and extracted by toluene in a Soxhlet apparatus. A small portion of the extract was used for gravimetric determination of fat. The remaining portion of the extract was cleaned on a silica gel column impregnated with H_2SO4, NaOH and $AgNO_3$. The extract was further purified and fractionated on an activated carbon column. The fraction containing PCDD/Fs, PCBs and HCB was analysed by HR GC-MS on Autospec Ultima NT.

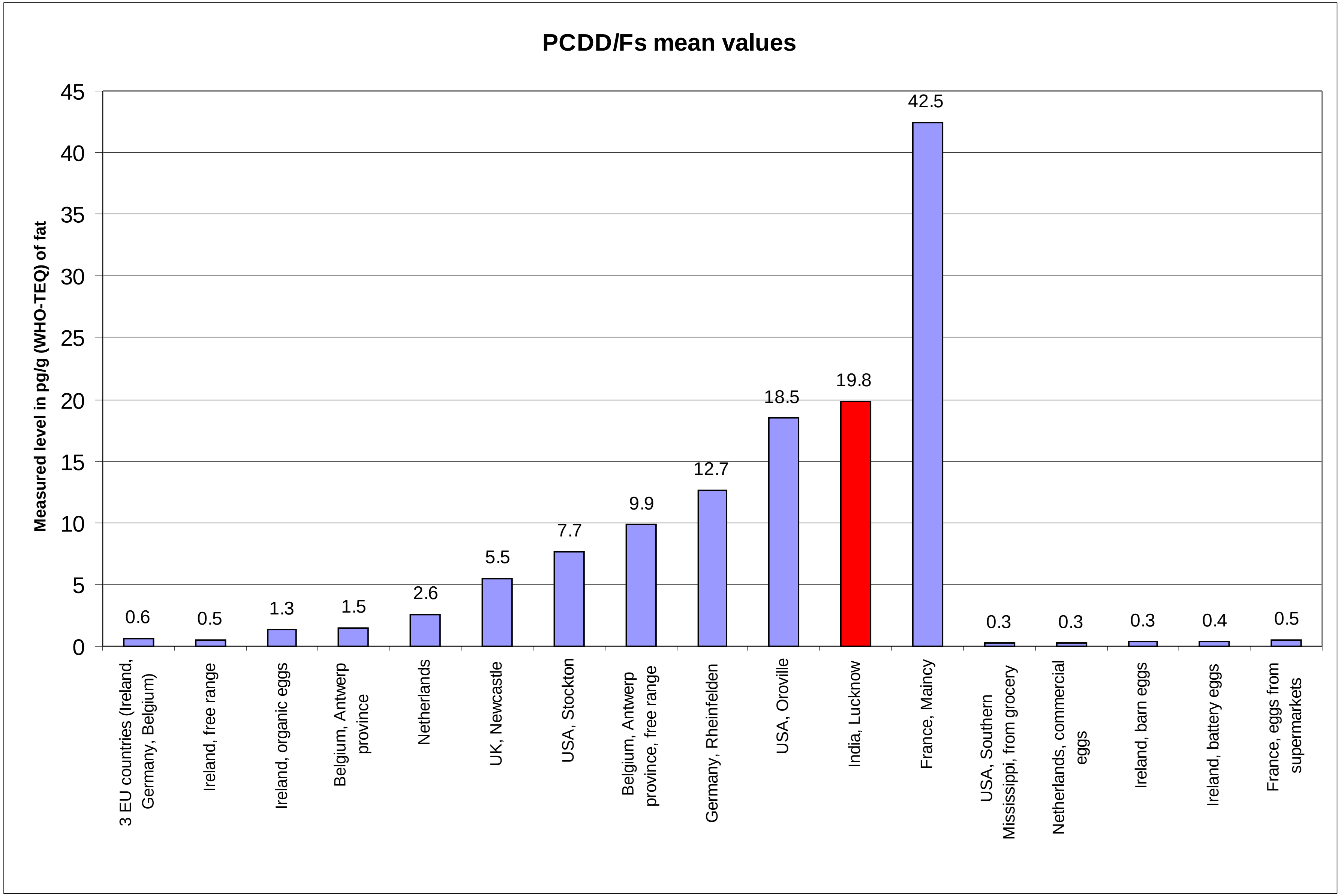
Analysis for PCDD/Fs, PCBs and HCB was done in the Czech Republic in laboratory Axys Varilab. Laboratory Axys Varilab, which provided the analysis is certified laboratory by the Institute for technical normalization, metrology and probations under Ministry of Industry and Traffic of the Czech Republic for analysis of POPs in air emissions, environmental compartments, wastes, food and biological materials.[a] Its services are widely used by industry as well as by Czech governmental institutions. In 1999, this laboratory worked out the study about POPs levels in ambient air of the Czech Republic on request of the Ministry of the Environment of the Czech Republic including also soils and blood tests.



Picture 1: Map of the medical waste incinerator and surrounding area.

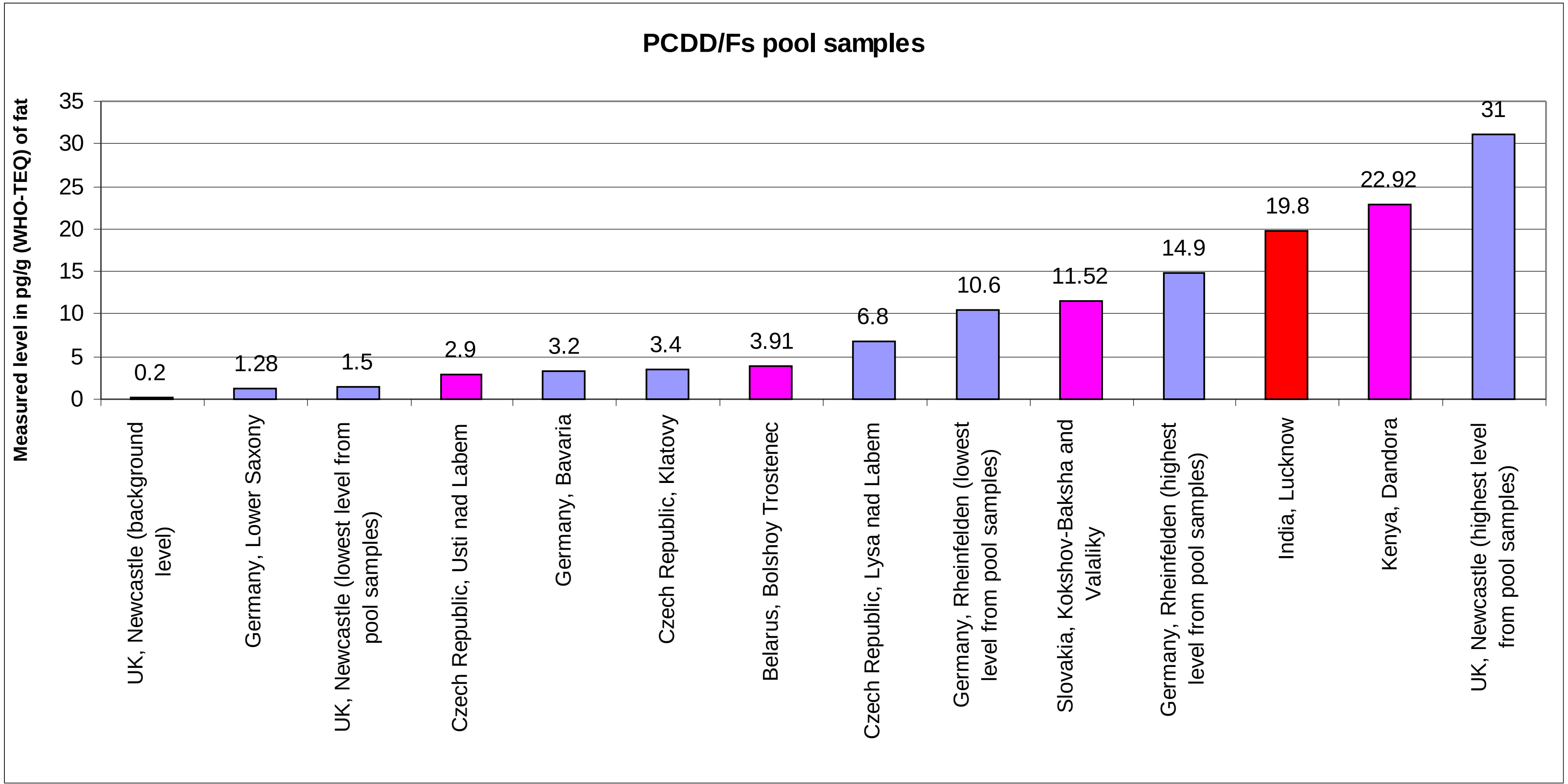
Annex 2: Mean values found within different groups of eggs from different parts of world

Country/locality	Year	Group	Measured level in pg/g (WHO-TEQ) of fat	Source of information
3 EU countries (Ireland, Germany, Belgium)	1997-2003	both	0.63	DG SANCO 2004
Ireland, free range	2002-2005	free range	0.47	Pratt, I. et al. 2004, FSAI 2004
Ireland, organic eggs	2002-2005	free range	1.30	Pratt, I. et al. 2004, FSAI 2004
Belgium, Antwerp province	2004	free range	1.50	Pussemeier, L. et al. 2004
Netherlands	2004	free range	2.60	SAFO 2004
UK, Newcastle	2002	free range	5.50	Pless-Mulloli, T. et al. 2003b
USA, Stockton	1994	free range	7.69	Harnly, M. E. et al. 2000
Belgium, Antwerp province, free range	2004	free range	9.90	Pussemeier, L. et al. 2004
Germany, Rheinfelden	1996	free range	12.70	Malisch, R. et al. 1996
USA, Oroville	1994	free range	18.46	Harnly, M. E. et al. 2000
India, Lucknow	2005	free range	19.80	Axys Varilab 2005
France, Maincy	2004	free range	42.47	Pirard, C. et al. 2004
USA, Southern Mississippi, from grocery	1994	not free range	0.29	Fiedler, H. et al. 1997
Netherlands, commercial eggs	2004	not free range	0.30	Anonymus 2004
Ireland, barn eggs	2002-2005	not free range	0.31	Pratt, I. et al. 2004, FSAI 2004
Ireland, battery eggs	2002-2005	not free range	0.36	Pratt, I. et al. 2004, FSAI 2004
France, eggs from supermarkets	1995-99	not free range	0.46	SCOOP Task 2000
Sweden, commercial eggs	1995-99	not free range	1.03	SCOOP Task 2000
Germany, commercial eggs	1995-99	not free range	1.16	SCOOP Task 2000
Spain, supermarkets	1996	not free range	1.34	Domingo et al. 1999
Finland, commercial eggs	1990-94	not free range	1.55	SCOOP Task 2000
Belgium, Antwerp province, conventional farms	2004	not free range	1.75	Pussemeier, L. et al. 2004


PCDD/Fs mean values
Measured level in pg/g (WHO-TEQ) of fat
45
40
35
30
25
20
15
10
5
0
0.6
0.5
1.3
1.5
2.6
5.5
7.7
9.9
12.7
18.5
19.8
42.5
0.3
0.3
0.3
0.4
0.5
3 EU countries (Ireland, Germany, Belgium)
Ireland, free range
Ireland, organic eggs
Belgium, Antwerp province
Netherlands
UK, Newcastle
USA, Stockton
Belgium, Antwerp province, free range
Germany, Rheinfelden
USA, Oroville
India, Lucknow
France, Maincy
USA, Southern Mississippi, from grocery
Netherlands, commercial eggs
Ireland, barn eggs
Ireland, battery eggs
France, eggs from supermarkets

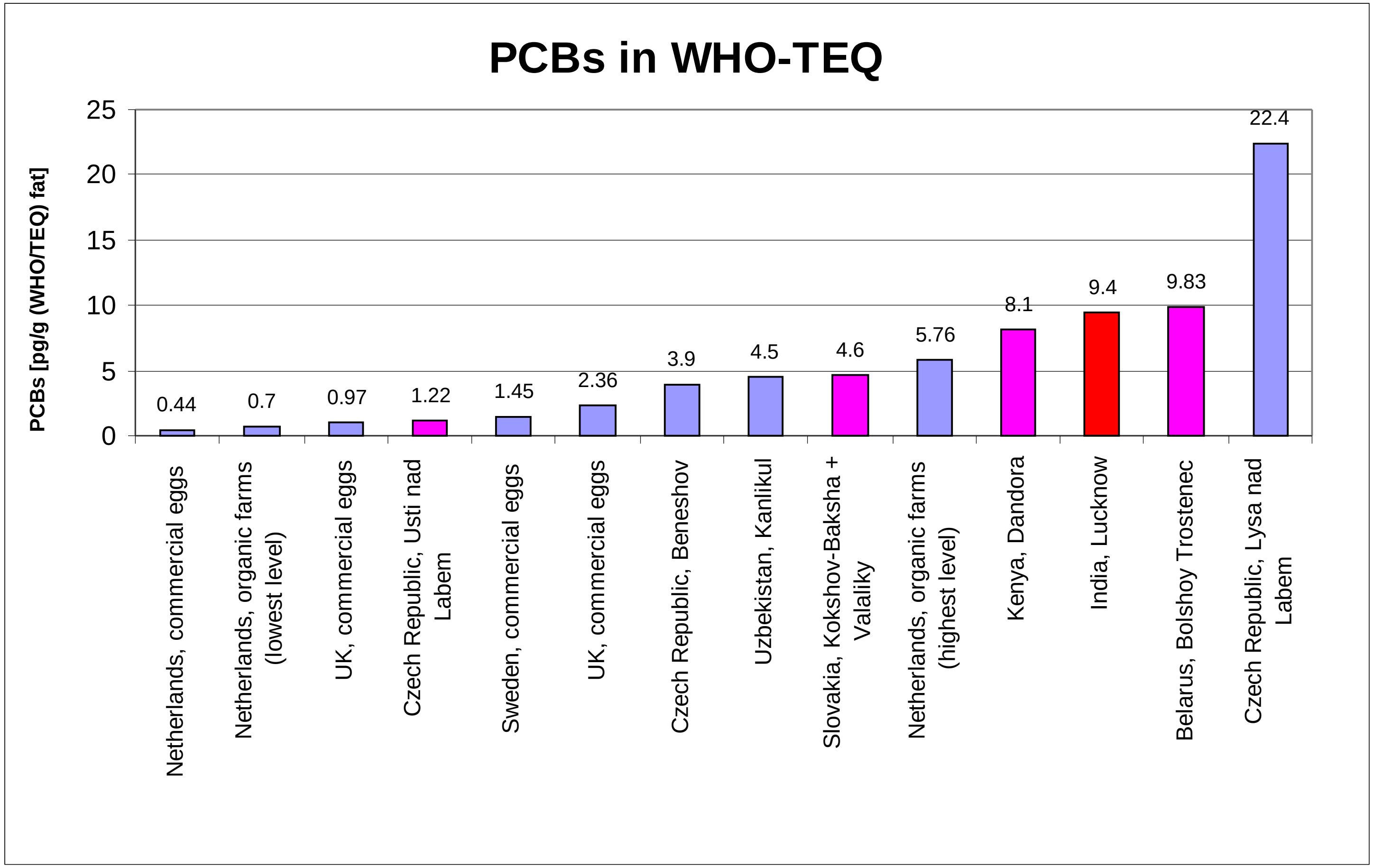
Annex 3: Levels of dioxins (PCDD/Fs) in different pool samples from different parts of world

Country/locality	Year	Group	Number of eggs/measured samples	Measured level in pg/g (WHO-TEQ) of fat	Source of information
UK, Newcastle (background level)	2000	free range	3/1 pooled	0.20	Pless-Mulloli, T. et al. 2001
Germany, Lower Saxony	1998	free range	60/6 pools	1.28	SCOOP Task 2000
UK, Newcastle (lowest level from pool samples)	2000	free range	3/1 pooled	1.50	Pless-Mulloli, T. et al. 2001
Czech Republic, Usti nad Labem	2005	free range	6/1 pooled	2.90	Axys Varilab 2005
Germany, Bavaria	1992	free range	370/37 pools	3.20	SCOOP Task 2000
Czech Republic, Klatovy	2003	free range	12	3.40	Beranek, M. et al. 2003
Belarus, Bolshoi Trostenec	2005	free range	6/1 pooled	3.91	Axys Varilab 2005
Czech Republic, Lysa nad Labem	2004	free range	4	6.80	Petrlik, J. 2005
Germany, Rheinfelden (lowest level from pool samples)	1996	free range	-	10.60	Malisch, R. et al. 1996
Slovakia, Kokshov-Baksha and Valaliky	2005	free range	6/1 pooled	11.52	Axys Varilab 2005
Germany, Rheinfelden (highest level from pool samples)	1996	free range	-	14.90	Malisch, R. et al. 1996
India, Lucknow	2005	free range	4/1 pooled	19.80	Axys Varilab 2005
Kenya, Dandora	2004	free range	6/1 pooled	22.92	Axys Varilab 2005
UK, Newcastle (highest level from pool samples)	2000	free range	3/1 pooled	31.00	Pless-Mulloli, T. et al. 2001


PCDD/Fs pool samples
Measured level in pg/g (WHO-TEQ) of fat
35
30
25
20
15
10
5
0
0.2
1.28
1.5
2.9
3.2
3.4
3.91
6.8
10.6
11.52
14.9
19.8
22.92
31
UK, Newcastle (background level)
Germany, Lower Saxony
UK, Newcastle (lowest level from pool samples)
Czech Republic, Usti nad Labem
Germany, Bavaria
Czech Republic, Klatovy
Belarus, Bolshoy Trostenec
Czech Republic, Lysa nad Labem
Germany, Rheinfelden (lowest level from pool samples)
Slovakia, Kokshov-Baksha and Valaliky
Germany, Rheinfelden (highest level from pool samples)
India, Lucknow
Kenya, Dandora
UK, Newcastle (highest level from pool samples)

Annex 4: Levels of PCBs in WHO-TEQ in different chicken eggs samples from different parts of world

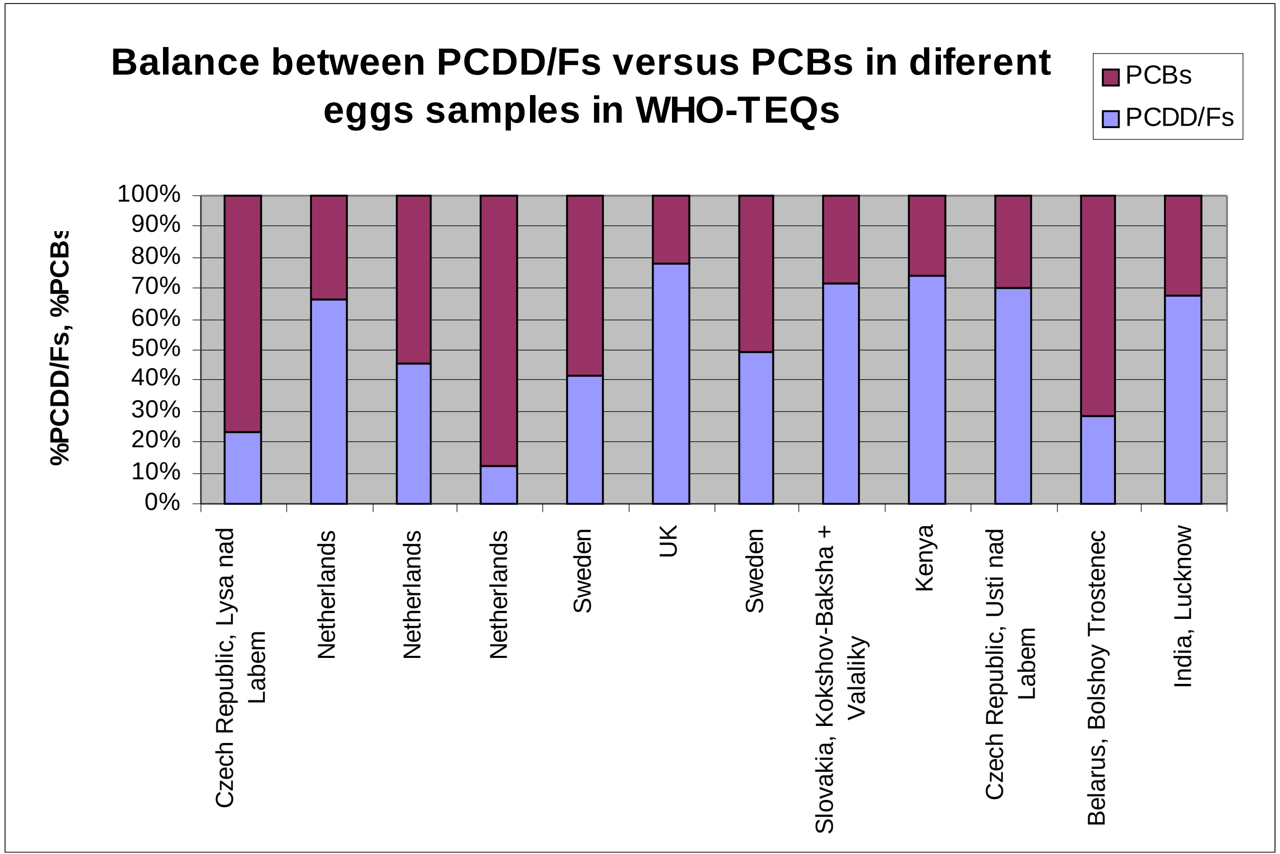
Country/locality	Year	Group	Number of measured samples	Specification	Measured level in pg/g (WHO-TEQ) of fat	Source of information
Netherlands, commercial eggs	1999	not free range	100/2 pools	pool, nonortho-PCBs	0.44	SCOOP Task 2000
Netherlands, organic farms (lowest level)	2002	free range	6	pool	0.70	Traag, W. et al. 2002
UK, commercial eggs	1992	not free range	24/1 pool	pool	0.97	SCOOP Task 2000
Czech Republic, Usti nad Labem	2005	free range	6/1 pool	pool	1.22	Axys Varilab 2005
Sweden, commercial eggs	1999	not free range	32/4 pools	pool	1.45	SCOOP Task 2000
UK, commercial eggs	1982	not free range	24/1 pool	pool	2.36	SCOOP Task 2000
Czech Republic, Beneshov	2004	free range	4	pool	3.90	Axys Varilab 2004
Uzbekistan, Kanlikul	2001	free range	-	individual	4.50	Muntean, N. et al. 2003
Slovakia, Kokshov-Baksha + Valaliky	2005	free range	6/1 pool	pool	4.60	Axys Varilab 2005
Netherlands, organic farms (highest level)	2002	free range	6	pool	5.76	Traag, W. et al. 2002
Kenya, Dandora	2004	free range	6/1 pool	pool	8.10	Axys Varilab 2005
India, Lucknow	2005	free range	4/1 pooled	pool	9.40	Axys Varilab 2005
Belarus, Bolshoi Trostenec	2005	free range	6/1 pool	pool	9.83	Axys Varilab 2005
Czech Republic, Lysa nad Labem	2004	free range	4	pool	22.40	Petrlik, J. 2005



PCBs in WHO-TEQ
PCBs [pg/g (WHO/TEQ) fat]
25
20
15
10
5
0
0.44
0.7
0.97
1.22
1.45
2.36
3.9
4.5
4.6
5.76
8.1
9.4
9.83
22.4
Netherlands, commercial eggs
Netherlands, organic farms (lowest level)
UK, commercial eggs
Czech Republic, Usti nad Labem
Sweden, commercial eggs
UK, commercial eggs
Czech Republic, Beneshov
Uzbekistan, Kanlikul
Slovakia, Kokshov-Baksha + Valaliky
Netherlands, organic farms (highest level)
Kenya, Dandora
India, Lucknow
Belarus, Bolshoy Trostenec
Czech Republic, Lysa nad Labem

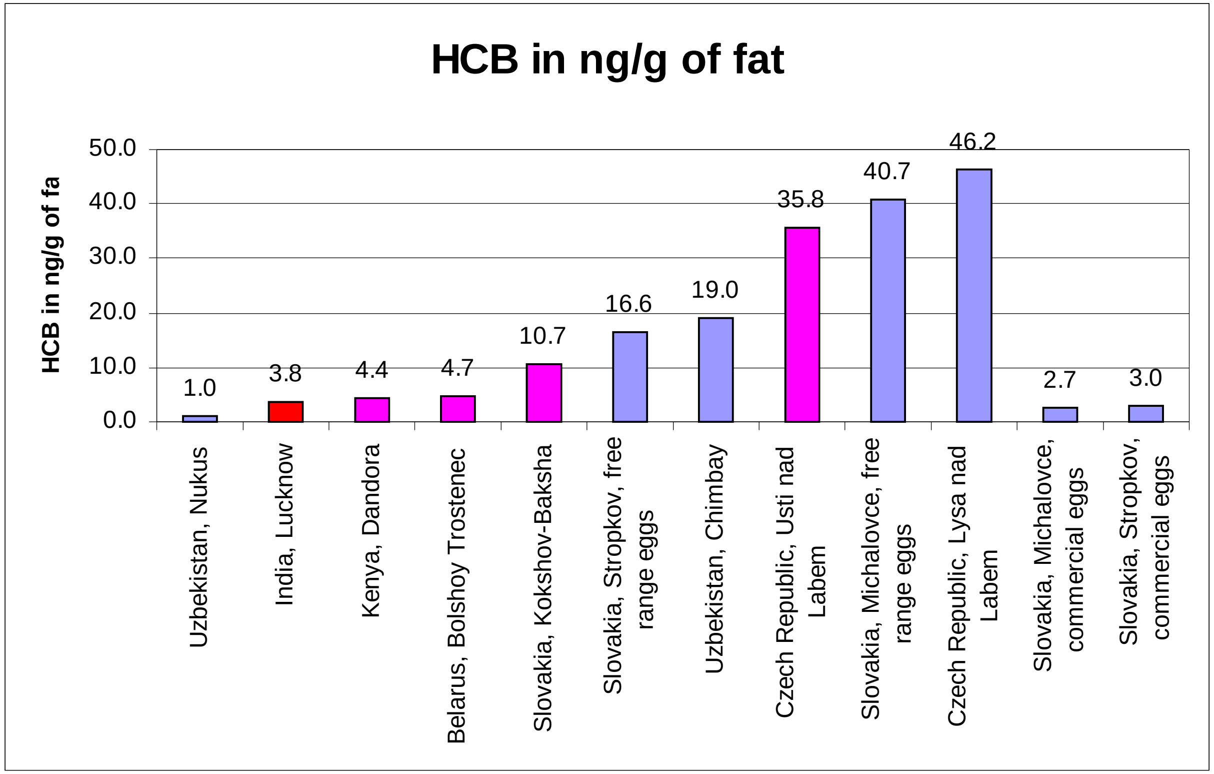
Annex 5: Balance between PCDD/Fs versus PCBs in diferent eggs samples in WHO-TEQs

Country/locality	Year	Group	PCDD/Fs	PCBs	Total WHO-TEQ	Source of information
Czech Republic, Lysa nad Labem	2004	free range	6.80	22.40	29.20	Petrlik, J. 2005
Netherlands	2002	free range	3.01	1.52	4.53	Traag, W. et al. 2002
Netherlands	2002	free range	4.74	5.76	10.50	Traag, W. et al. 2002
Netherlands	2002	free range	0.70	4.89	5.59	Traag, W. et al. 2002
Sweden	1993	mixed	1.31	1.82	3.13	SCOOP Task 2000
UK	1982	not free range	8.25	2.36	10.61	SCOOP Task 2000
Sweden	1999	not free range	1.43	1.45	2.48	SCOOP Task 2000
Slovakia, Kokshov-Baksha	2005	free range	11.52	4.60	16.12	Axys Varilab 2005
Kenya	2004	free range	22.92	8.1	31.02	Axys Varilab 2005
Czech Republic, Usti nad Labem	2005	free range	2.9	1.22	4.12	Axys Varilab 2005
Belarus, Bolshoi Trostenec	2005	free range	3.91	9.83	13.74	Axys Varilab 2005
India, Lucknow	2005	free range	19.8	9.4	29.2	Axys Varilab 2005


Balance between PCDD/Fs versus PCBs in diferent eggs samples in WHO-TEQs
PCBs
PCDD/Fs
%PCDD/Fs, %PCBs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Czech Republic, Lysa nad Labem
Netherlands
Netherlands
Netherlands
Sweden
UK
Sweden
Slovakia, Kokshov-Baksha + Valaliky
Kenya
Czech Republic, Usti nad Labem
Belarus, Bolshoy Trostenec
India, Lucknow

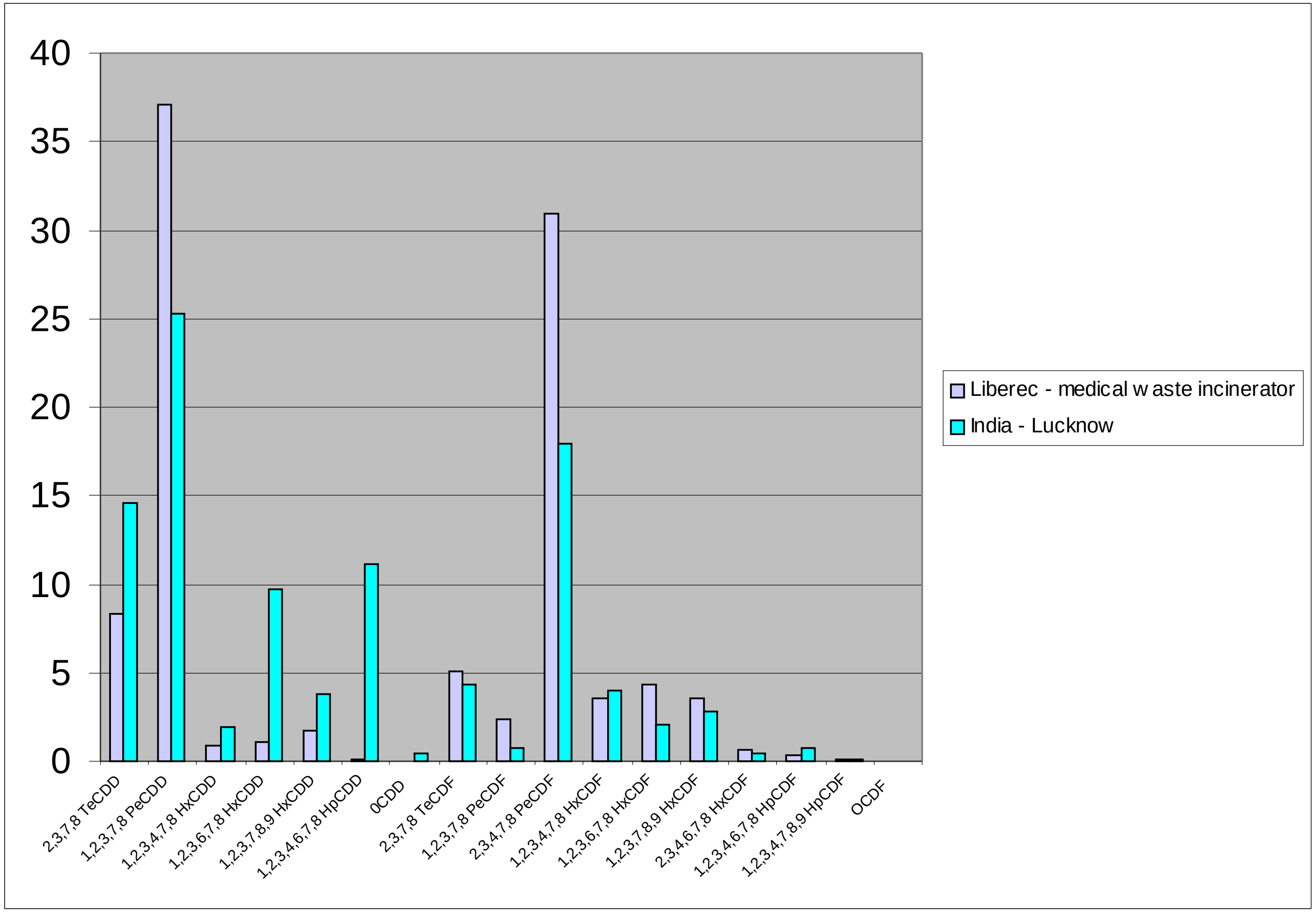
Annex 6: Levels of HCB in ng/g of fat in different chicken eggs samples from different parts of world

Country	Date/year	Specification	Number of measured samples	Measured level in ng/g of fat	Source of information
Uzbekistan, Nukus	2001	free range	-	1.0	Muntean, N. et al. 2003
India, Lucknow	2005	free range	4/1 pooled	3.8	Axys Varilab 2005
Kenya, Dandora	2004	free range	6/1 pool	4.4	Axys Varilab 2005
Belarus, Bolshoi Trostenec	2005	free range	6/1 pool	4.7	Axys Varilab 2005
Slovakia, Kokshov-Baksha	2005	free range	6/1 pool	10.7	Axys Varilab 2005
Slovakia, Stropkov, free range eggs	before 1999	free range	1	16.6	Kocan, A. et al. 1999
Uzbekistan, Chimbay	2001	free range	-	19.0	Muntean, N. et al. 2003
Czech Republic, Usti nad Labem	2005	free range	6/1 pool	35.8	Axys Varilab 2005
Slovakia, Michalovce, free range eggs	before 1999	free range	1	40.7	Kocan, A. et al. 1999
Czech Republic, Lysa nad Labem	2004	free range	4/1 pool	46.2	Petrlik, J. 2005
Slovakia, Michalovce, commercial eggs	before 1999	not free range	1	2.7	Kocan, A. et al. 1999
Slovakia, Stropkov, commercial eggs	before 1999	not free range	1	3.0	Kocan, A. et al. 1999



HCB in ng/g of fat
HCB in ng/g of fa
50.0
40.0
30.0
20.0
10.0
0.0
1.0
3.8
4.4
4.7
10.7
16.6
19.0
35.8
40.7
46.2
2.7
3.0
Uzbekistan, Nukus
India, Lucknow
Kenya, Dandora
Belarus, Bolshoy Trostenec
Slovakia, Kokshov-Baksha
Slovakia, Stropkov, free range eggs
Uzbekistan, Chimbay
Czech Republic, Usti nad Labem
Slovakia, Michalovce, free range eggs
Czech Republic, Lysa nad Labem
Slovakia, Michalovce, commercial eggs
Slovakia, Stropkov, commercial eggs

Annex 7: Comparison of medical waste incinerator dioxins pattern with more developed APC device with Lucknow eggs pattern expressed in WHO-TEQs



Annex 8: Photos

Picture 1: The Medical Waste Incinerator in the of Queen Mary's Hospital in Lucknow (Uttar Pradesh, India). Photo by: Upasana Choudhry.

Picture 2: Foraging chicken at the sampling location. Photo by: Upasana Choudhry.

Picture 3: Chicken at sampling location.
Photo by: Upasana Choudhry.

Picture 4: Primary chamber of theQueen Mary's Hospital, Lucknow medical waste incinerator
Photo by: Upasana Choudhry.

Picture 5: Second chamber of theQueen Mary's Hospital, Lucknow medical waste incinerator
Photo by: Upasana Choudhry.

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