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Contamination of chicken eggs near the cement kilns in Minas, Uruguay 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 two cement kilns in Minas, Uruguay showed levels of polychlorinated biphenyls (PCBs) expressed in WHO-TEQs that were two times higher than the proposed limit in European Union (EU). In addition, dioxin levels in the eggs exceeded the newly proposed EU action level and were almost two-fold higher than background levels.. To our knowledge, this study represents the first data about U-POPs in chicken eggs from Uruguay.

Cement kilns located close to the city of Minas were pointed out as potential sources of POPs releases in the region, but further monitoring of possible PCBs content in their fuels is needed. The companies apparently do not monitor the chlorine content of the materials they burn and do not measure the pollutants released during their operation. A stream that eventually serves as a source of drinking water runs near the plants. In 2004, a significant quantity of hyperthyroidism cases emerged in the area near the kilns along with other serious health problems. This study indicates that better monitoring of cement kiln operations as a potential U-POPs source is needed in developing countries and in countries with economies under transition in general.

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 in Uruguay. Uruguay is a Party to Convention since it ratified the Treaty in February 2004. 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 Uruguayan 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 Uruguay's governmental representatives and all stakeholders to honor the integrity of the Convention text and keep the promise of reduction and elimination of POPs.

Recommendations

1) Include PCBs in the UNEP Toolkit and elevate the importance of PCBs releases in the guidelines for Best Available Techniques (BAT) and Best Environmental Practices and all other documents prepared under the Stockholm Convention.

2) More POPs monitoring in Uruguay is needed;

3) More publicly accessible data about U-POPs releases from cement kilns in developing countries and countries with economies under transition are needed to address these sources of U-POPs properly;

4) A PCBs releases inventory would help to properly address all sources of their releases in Uruguay and may help identify sources useful to other Latin American countries;

5) Stringent limits for PCBs in both fuel and waste as well as air emissions should be introduced into both national legislation and under international treaties.

6) Prohibit cement kilns from firing hazardous waste including fuels containing POPs or chlorinated substance that could lead to POPs formation.

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 in Uruguay. Uruguay ratified the Convention in February 2004.

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 surroundings of two cement kilns near Minas, Uruguay were selected as a sampling site since cement kilns are known to be significant sources of U-POPs.[1] 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 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 POPs in eggs in Uruguay.

Materials and Methods

Please see Annex 1.

Results and Discussion

U-POPs in eggs sampled near Minas, Uruguay

The results of the analysis of a pooled sample of 8 eggs collected within a 2 km distance from the cement kilns ANCAP and CUSCA (see further text about these plants) close to the city of Minas are summarized in Tables 1 and 2. Pooled sample fat content was measured at 10.7%.

The sampled eggs exceeded the newly proposed EU limit for PCBs by almost two-fold. In addition, the eggs exceeded the newly proposed EU limit for sum of PCDD/Fs and PCBs expressed in WHO-TEQ. The level of dioxins exceeded the proposed EU action level for these chemicals as well as the limit for dioxins content in egg fat for use as feedstuffs.

Table 1: Measured levels of POPs in eggs collected near two cement kilns in Minas, Uruguay per gram of fat.

	Measured level	Limits	Action level
PCDD/Fs in WHO-TEQ (pg/g)	2.18	3.0[a]	2.0 [b]
PCBs in WHO-TEQ (pg/g)	3.75	2.0 [b]	1.5 [b]
Total WHO-TEQ (pg/g)	5.93	5.0 [b]	-
PCB (7 congeners) (ng/g)	29.00	200 [c]	-
HCB (ng/g)	1.40	200[d]	-

Abbreviations: WHO, World Health Organization; TEQ, toxic equivalents; pg, picogram; 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.

Table 2 shows the levels of U-POPs in eggs expressed as fresh weight.

Table 2: Measured levels of POPs in eggs collected near two cement kilns in Minas, Uruguay per gram of egg fresh weight.

	Measured level	Limits	Action level
PCDD/Fs in WHO-TEQ (pg/g)	0.23	1[a]	-
PCBs in WHO-TEQ (pg/g)	0.40	-	-
Total WHO-TEQ (pg/g)	0.64	-	-
PCBs (7 congeners) (ng/g)	3.10	-	-
HCB (ng/g)	0.15	-	-

[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 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 Uruguay. The levels of dioxins exceeding the EU action level observed in the egg samples support the need for further monitoring and longer-term changes to eliminate chlorinated chemicals that serve as donors for PCBs, dioxins and furans releases in all environment compartments. As PCBs are not fully covered as U-POPs by all relevant documents and/or their drafts prepared under Stockholm Convention, it is very important to close this gap and introduce stricter rules for handling PCBs-containing wastes and fuels as well as for PCBs releases into the environment. Finally, more data about U-POPs releases from cement kilns U-POPs in developing countries and countries with economies under transition are needed.

It is clear that among the U-POPs listed under the Stockholm Convention , PCBs are the main contaminants found in the eggs from Minas. HCB was almost at the background levels (see Annex 6).

Comparison with other studies of eggs

We compared the levels of PCBs and PCDD/Fs measured in this study with data from other studies that also used pooled samples and/or expressed mean values of analyzed eggs (please see Annexes 2, 3 and 4). The data for eggs described in this report follow on the heels of a similar studies in Slovakia, Kenya, Czech Republic, Belarus, India (Uttar Pradesh), Tanzania, Senegal, Mexico, Turkey and Bulgaria released since 21 March 2005.[2, 3, 4, 5, 6, 7, 8, 9, 10, 11] The dioxin levels in eggs in this study exceeded background levels by almost 2-fold (0.2 - 1.2 pg WHO-TEQ/g of fat).

Some other studies showing elevated levels of dioxins include samples near a chemical plant in Usti nad Labem, Czech Republic,[12] where comparable levels of dioxins (2.9 pg WHO-TEQ/g of fat) were found. Much higher levels (almost 15-times and more) were found near an old waste incinerator in Maincy, France[13] and an area affected by a spread mixture of waste incineration residues in Newcastle, UK,[14] with levels measured at 42.47 pg WHO-TEQ/g and 31 pg WHO-TEQ/g respectively.

PCBs levels expressed in WHO-TEQs in eggs collected near Minas are comparable to those found in free range eggs from neighborhood of Mbeubeuss dumpsite in Senegal[15] and/or from Beneshov in the Czech Republic (near a medical waste incinerator).

PCBs contribute over 60% of the whole WHO-TEQ value in these eggs as visible from the graph in Annex 5.

Possible U-POPs sources

The elevated levels of PCBs and PCDD/Fs observed in this study provoke the question of possible sources. There are two major potential pollution sources: the two cement kilns. Another potential source of PCDD/Fs could also be open burning. Since there is no specific data about U-POPs measurements from the region, it is difficult to identify sources.

Since the major pollutant found in the eggs was PCBs, it is reasonable to question whether cement kilns can create PCBs. According to data from Poland shown in Table 3 they can. The data shows significant levels of PCBs produced from the Polish incinerator when burning coal or co-incinerating waste.

Table 3: Measurements of POPs in cement kilns in Poland.[16]

Cement kiln	PCDD/F ng-TEQ/m^3	PCBs ng-TEQ/m^3	HCB ng-TEQ/m^3
Co-incinerating waste	0.070	8.95	44.2
Burning coal	0.055	4.45	2.90

One of the cement kilns near Minas in this study reportedly burns rice peel and fuel oil. Fuel oil can be sometimes contaminated by used oil with PCBs, but there is no data on the actual PCBs contents in these fuels. Monitoring data on the fuel and the cement kiln would help clarify these questions. In fact, more monitoring data on cements kilns in general is needed. Therefore we urge international as well as national institutions to strength U-POPs monitoring capacity in the region perhaps by developing a regional U-POPs monitoring project.

Minas and cement kilns

Physical and administrative description, environmental and health consequences

The potential pollution sources are two cement kilns located between 36 º and 37 º latitude south, and aprox. 117 meters., altitude. The closest city to the cement kilns is “Minas”, which is 3-5 km away from from them at sea level., The winds can distribute the emissions from the kilns among the population in the urban and suburban area (see map at Picture 1 in Annex 1). Minas is the capitol of the department of “Lavalleja” in southeast Uruguay. It has a population of 37,149 habitants.

There is a stream. “La Plata” (The Silver), which passes only 20-50 meters from the cement plants. This stream runs down to another stream, “San Francisco”, which serves as a source of drinking water to the population of Minas and the adjacent area.

Several serious illnesses have been observed recently in Minas. In 2004, a significant quantity of cases of hyperthyroidism occurred in the neighbourhoods near the cement kiln. Strong evidence links hyperthyroidism to PBBs, PCBs, substituted phenols, dioxins, perchlorates, and the flame retardants, PBDEs.[17] According to the population living adjacent to the cement plants a series of health problems have been observed including: endocrine dysfunction, birth defects, abortions, respiratory and urinary problems. In addition, birth defects and abortions were also observed among the animals in the zone.

Cement kilns close to Minas in Uruguay

Two different cement kilns are located within the studied area: 1) The ANCAP cement plant (Administración Nacional de Combustibles, Alcohol y Portland), a state owned company, located 5 km. from the urban zone of the city of Minas; and 2) The CUCSA cement plant (Compañía Uruguaya de Cemento Sociedad Anónima), a private company with investors from Spain.

The ANCAP, Pórtland cement factory located in Minas initiated operations in 1954 and according to to the compnay has two cement kilns with a production capacity 350 tons a day each. In 2003, this plant produced 120,000 tons of clinker. More data about ANCAP’s operation are in its annual reports.[18]

The ANCAP cement kiln burns fuel oil and rice peel. The combustion of rice peel does not generate solid residue and the fraction of inorganic matter is incorporated in the clinker. The combustion of these fuels in the kilns produces significant pollution: carbon dioxide, nitrogen oxide, sulphur dioxide and potentially others, but they are not measured.

The company admits that it does not regularly analyze the chlorine content of the rice peel or the fuel oil used as fuel. When a decision is made to use a cement kiln to burn POPs wastes or other halogenated wastes, the operator and national regulatory authorities should both be aware that this practice has the potential to generate and release large quantities of U-POPs to the environment as the Stockholm Convention correctly states.

The CUSCA cement kiln was installed in February 1997. It produces 1,400 tons of clinker daily and consumes 120 tons fuel oil per day.[19]

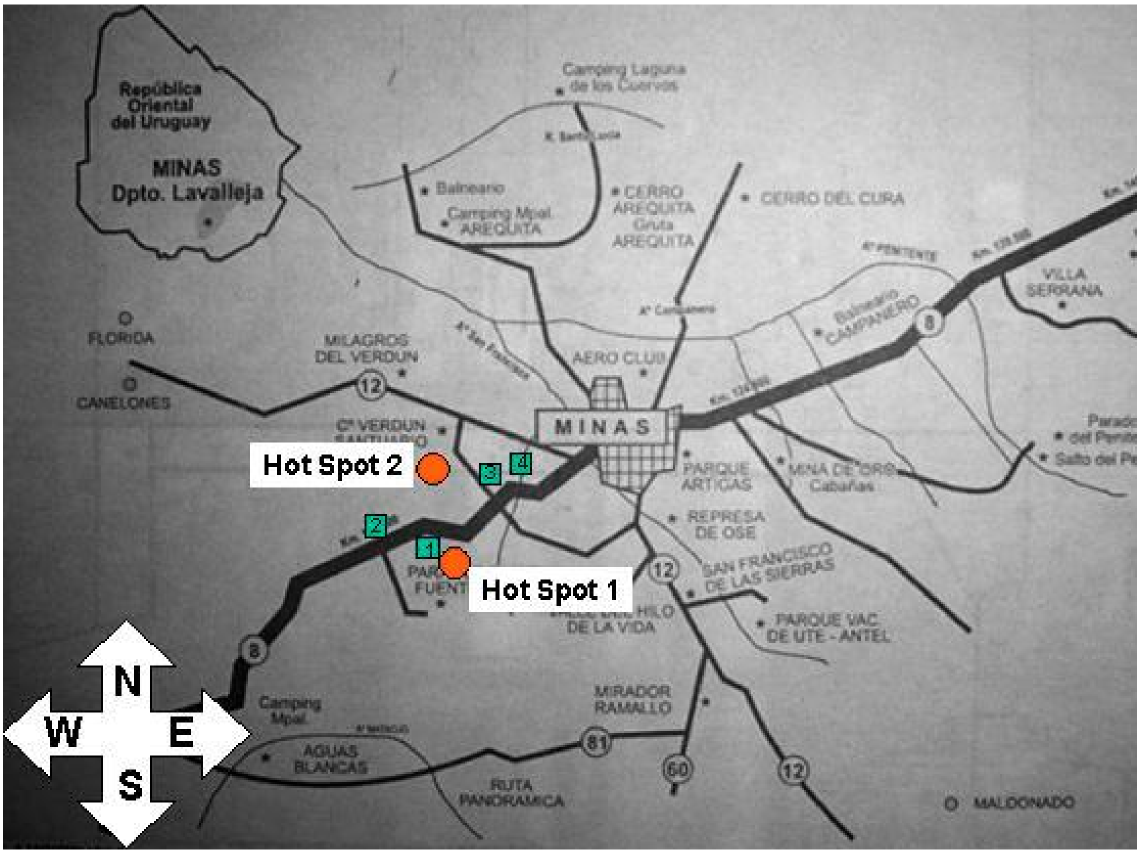
U-POPs and the Stockholm Convention

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 in Uruguay. Uruguay is a Party to Convention since it ratified the Treaty in 2004.

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.[a] 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).[b] In addition, Parties are to promote both BAT and best environmental practices (BEP) for all new and existing significant source categories,[c] 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.[d] 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 Uruguayan 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 Uruguayan governmental representatives and all stakeholders to honor the integrity of the Convention text and keep the promise of reduction and elimination of POPs.

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



Picture 1: Map of Minas and surrounding with marked location of cement kilns (hot spot 1 = cement kiln ANCAP, hot spot 2 = cement kiln CUSCA and sampling places - 4 different chicken fanciers who provided their free range chicken eggs for IPEN's research.

Annex 1. Materials and Methods

Sampling

For sampling in Uruguay we have chosen the surroundings of two cement kilns close to the city of Minas.

The eggs were collected from four sites (see map at picture 1). The hens from which the eggs were picked were all free-range of age between 2 - 3 years although regularly provided with maize once at day, and the rest of their feeding is what they get from the soil.

Sampling was done by members of REDES-AT and RAPAL Uruguay on 20 January 2005. Four chicken fancier supplied 16 eggs from their free range chickens. The eggs were kept in cool conditions after sampling and then were boiled in Uruguay for 7 - 10 minutes in pure water and transported by express service to the laboratory at ambient temperature.

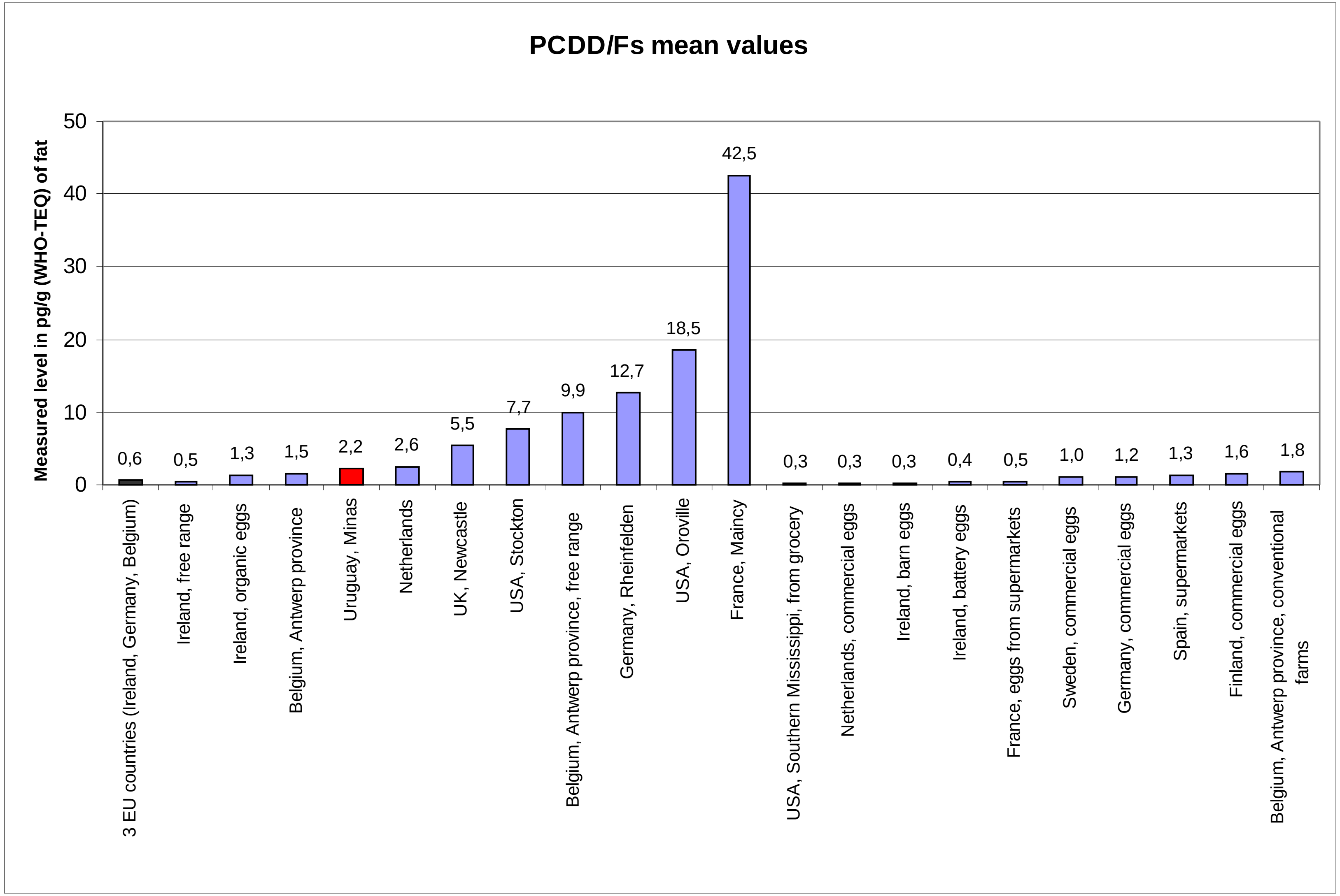
Analysis

After being received by the laboratory, the eggs were kept frozen until analysis. The egg shells were removed and the edible contents of 8 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.

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

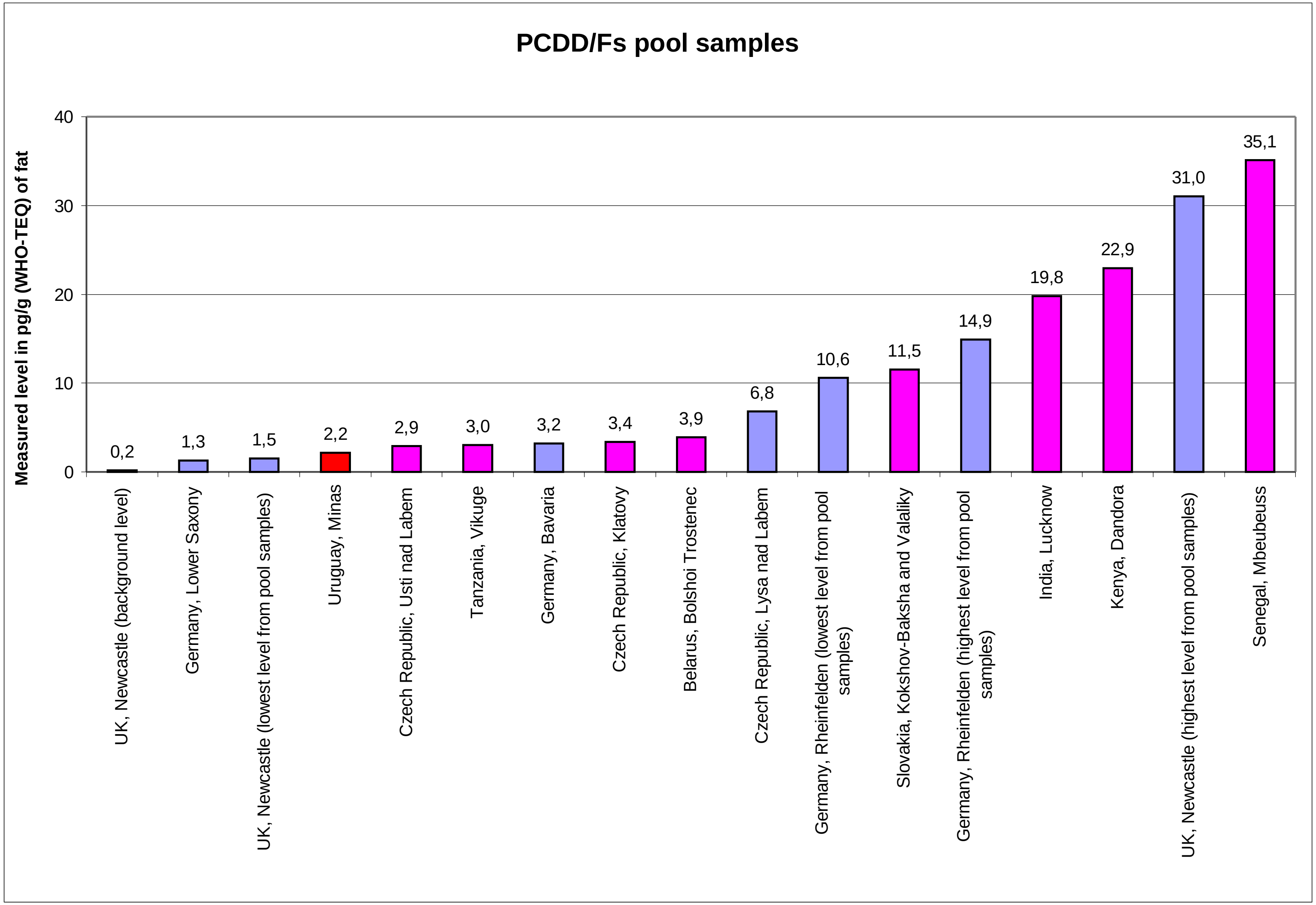
Country/locality	Year	Group	Measured level in pg/g (WHO-TEQ) of fat	Source of information
3 EU countries (Ireland, Germany, Belgium)	1997-2003	both	0,63	DG SANCO 2004
Ireland, free range	2002-2005	free range	0,47	Pratt, I. et al. 2004, FSAI 2004
Ireland, organic eggs	2002-2005	free range	1,3	Pratt, I. et al. 2004, FSAI 2004
Belgium, Antwerp province	2004	free range	1,5	Pussemeier, L. et al. 2004
Uruguay, Minas	2005	free range	2,18	Axys Varilab 2005
Netherlands	2004	free range	2,6	SAFO 2004
UK, Newcastle	2002	free range	5,5	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	9,9	Pussemeier, L. et al. 2004
Germany, Rheinfelden	1996	free range	12,7	Malisch, R. et al. 1996
USA, Oroville	1994	free range	18,46	Harnly, M. E. et al. 2000
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	0,3	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
50
40
30
20
10
0
0,6
0,5
1,3
1,5
2,2
2,6
5,5
7,7
9,9
12,7
18,5
42,5
0,3
0,3
0,3
0,4
0,5
1,0
1,2
1,3
1,6
1,8
3 EU countries (Ireland, Germany, Belgium)
Ireland, free range
Ireland, organic eggs
Belgium, Antwerp province
Uruguay, Minas
Netherlands
UK, Newcastle
USA, Stockton
Belgium, Antwerp province, free range
Germany, Rheinfelden
USA, Oroville
France, Maincy
USA, Southern Mississippi, from grocery
Netherlands, commercial eggs
Ireland, barn eggs
Ireland, battery eggs
France, eggs from supermarkets
Sweden, commercial eggs
Germany, commercial eggs
Spain, supermarkets
Finland, commercial eggs
Belgium, Antwerp province, conventional farms

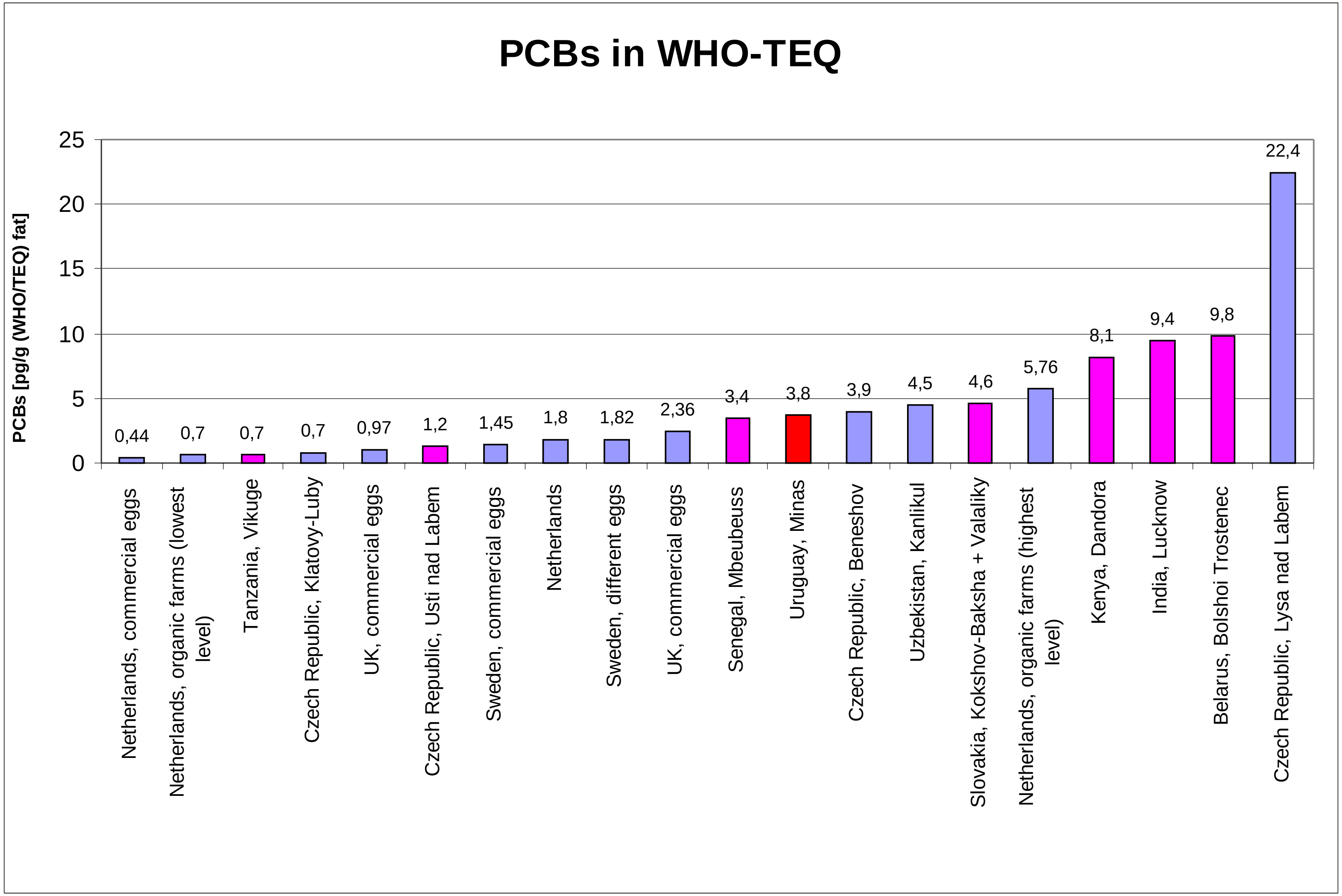
Annex 3: Levels of dioxins (PCDD/Fs) in different pool samples from different parts of world

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	0,2	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	1,5	Pless-Mulloli, T. et al. 2001
Uruguay, Minas	2005	free range		2,18	Axys Varilab 2005
Czech Republic, Usti nad Labem	2005	free range	6/1 pooled	2,9	Axys Varilab 2005
Tanzania, Vikuge	2005	free range	6/1 pooled	3,03	Axys Varilab 2005
Germany, Bavaria	1992	free range	370/37 pools	3,2	SCOOP Task 2000
Czech Republic, Klatovy	2003	free range	12	3,4	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	6,8	Petrlik, J. 2005
Germany, Rheinfelden (lowest level from pool samples)	1996	free range	-	10,6	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	-	14,9	Malisch, R. et al. 1996
India, Lucknow	2005	free range	4/1 pooled	19,8	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	Pless-Mulloli, T. et al. 2001
Senegal, Mbeubeuss	2005	free range		35,1	Axys Varilab 2005


PCDD/Fs pool samples
Measured level in pg/g (WHO-TEQ) of fat
0
10
20
30
40
0,2
1,3
1,5
2,2
2,9
3,0
3,2
3,4
3,9
6,8
10,6
11,5
14,9
19,8
22,9
31,0
35,1
UK, Newcastle (background level)
Germany, Lower Saxony
UK, Newcastle (lowest level from pool samples)
Uruguay, Minas
Czech Republic, Usti nad Labem
Tanzania, Vikuge
Germany, Bavaria
Czech Republic, Klatovy
Belarus, Bolshoi 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)
Senegal, Mbeubeuss

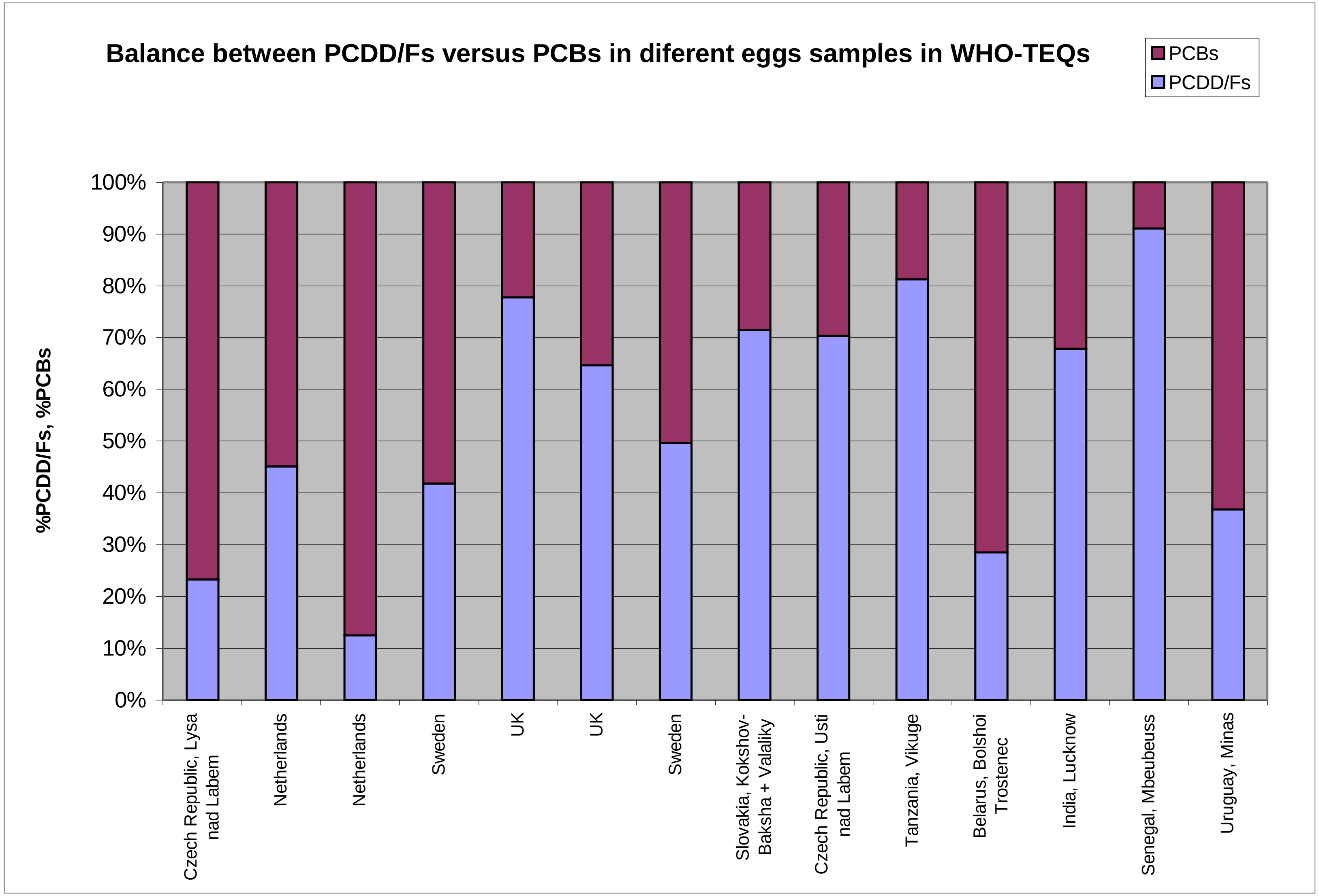
Annex 4: Levels of PCBs in WHO-TEQ in different chicken eggs samples from different parts of world

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	0,7	Traag, W. et al. 2002
Tanzania, Vikuge	2005	free range	6/1 pool	pool	0,7	Axys Varilab 2005
Czech Republic, Klatovy-Luby	2003	free range	free range	individual	0,7	Beranek, M. et al. 2003
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	1,2	Axys Varilab 2005
Sweden, commercial eggs	1999	not free range	32/4 pools	pool	1,45	SCOOP Task 2000
Netherlands	1990	mixed	8/2 pools	pool, nonortho-PCBs	1,8	SCOOP Task 2000
Sweden, different eggs	1993	mixed	84/7 pools	pool	1,82	SCOOP Task 2000
UK, commercial eggs	1982	not free range	24/1 pool	pool	2,36	SCOOP Task 2000
Senegal, Mbeubeuss	2005	free range		pool	3,4	Axys Varilab 2005
Uruguay, Minas	2005	free range		pool	3,8	Axys Varilab 2005
Czech Republic, Beneshov	2004	free range	4	pool	3,9	Axys Varilab 2004
Uzbekistan, Kanlikul	2001	free range	-	individual	4,5	Muntean, N. et al. 2003
Slovakia, Kokshov-Baksha + Valaliky	2005	free range	6/1 pool	pool	4,6	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	8,1	Axys Varilab 2005
India, Lucknow	2005	free range	4/1 pooled	pool	9,4	Axys Varilab 2005
Belarus, Bolshoi Trostenec	2005	free range	6/1 pool	pool	9,8	Axys Varilab 2005
Czech Republic, Lysa nad Labem	2004	free range	4	pool	22,4	Petrlik, J. 2005


PCBs in WHO-TEQ
PCBs [pg/g (WHO/TEQ) fat]
25
20
15
10
5
0
0,44
0,7
0,7
0,7
0,97
1,2
1,45
1,8
1,82
2,36
3,4
3,8
3,9
4,5
4,6
5,76
8,1
9,4
9,8
22,4
Netherlands, commercial eggs
Netherlands, organic farms (lowest level)
Tanzania, Vikuge
Czech Republic, Klatovy-Luby
UK, commercial eggs
Czech Republic, Usti nad Labem
Sweden, commercial eggs
Netherlands
Sweden, different eggs
UK, commercial eggs
Senegal, Mbeubeuss
Uruguay, Minas
Czech Republic, Beneshov
Uzbekistan, Kanlikul
Slovakia, Kokshov-Baksha + Valaliky
Netherlands, organic farms (highest level)
Kenya, Dandora
India, Lucknow
Belarus, Bolshoi Trostenec
Czech Republic, Lysa nad Labem

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

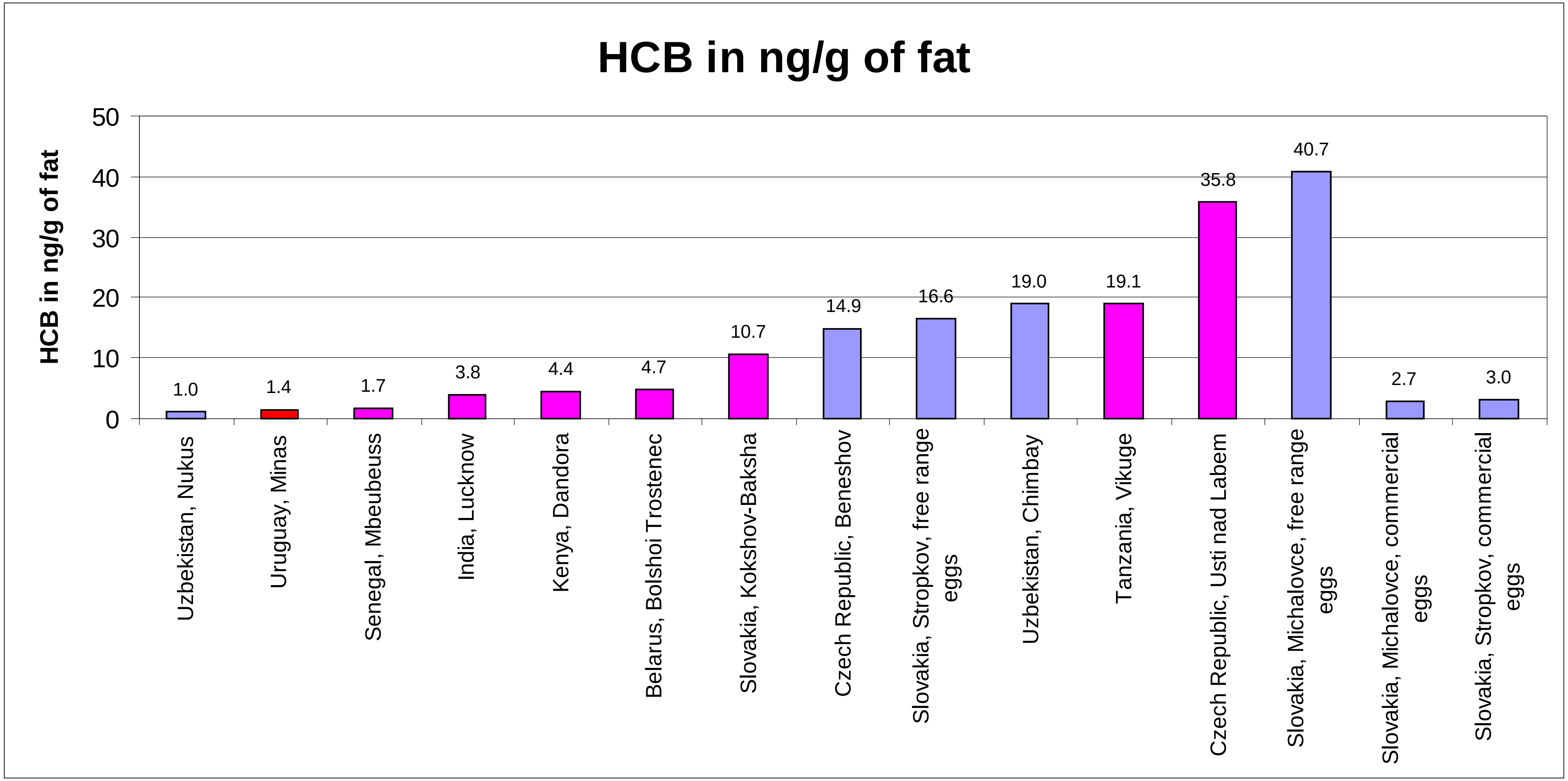
Country/locality	Year	Group	PCDD/Fs	PCBs	Total WHO-TEQ	Source of information
Czech Republic, Lysa nad Labem	2004	free range	6,80	22,40	29,20	Petrlik, J. 2005
Netherlands	2002	free range	4,74	5,76	10,50	Traag, W. et al. 2002
Netherlands	2002	free range	0,70	4,89	5,59	Traag, W. et al. 2002
Sweden	1993	mixed	1,31	1,82	3,13	SCOOP Task 2000
UK	1982	not free range	8,25	2,36	10,61	SCOOP Task 2000
UK	1992	not free range	1,77	0,97	2,74	SCOOP Task 2000
Sweden	1999	not free range	1,43	1,45	2,48	SCOOP Task 2000
Slovakia, Kokshov-Baksha + Valaliky	2005	free range	11,52	4,60	16,12	Axys Varilab 2005
Czech Republic, Usti nad Labem	2005	free range	2,9	1,22	4,12	Axys Varilab 2005
Tanzania, Vikuge	2005	free range	3,03	0,7	3,73	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
Senegal, Mbeubeuss	2005	free range	35,1	3,44	38,54	Axys Varilab 2005
Uruguay, Minas	2005	free range	2,18	3,75	5,93	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
Sweden
UK
UK
Sweden
Slovakia, Kokshov-Baksha + Valaliky
Czech Republic, Usti nad Labem
Tanzania, Vikuge
Belarus, Bolshoi Trostenec
India, Lucknow
Senegal, Mbeubeuss
Uruguay, Minas

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
Uruguay, Minas	2005	free range		1,4	Axys Varilab 2005
Senegal, Mbeubeuss	2005	free range		1,7	Axys Varilab 2005
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
Czech Republic, Beneshov	2004	free range	4/1 pool	14,9	Axys Varilab 2004
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
Tanzania, Vikuge	2005	free range	6/1 pool	19,1	Axys Vailab 2005
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
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 fat
50
40
30
20
10
0
1.0
1.4
1.7
3.8
4.4
4.7
10.7
14.9
16.6
19.0
19.1
35.8
40.7
2.7
3.0
Uzbekistan, Nukus
Uruguay, Minas
Senegal, Mbeubeuss
India, Lucknow
Kenya, Dandora
Belarus, Bolshoi Trostenec
Slovakia, Kokshov-Baksha
Czech Republic, Beneshov
Slovakia, Stropkov, free range eggs
Uzbekistan, Chimbay
Tanzania, Vikuge
Czech Republic, Usti nad Labem
Slovakia, Michalovce, free range eggs
Slovakia, Michalovce, commercial eggs
Slovakia, Stropkov, commercial eggs

Annex 7: Photos

Picture 1: ANCAP Cement plant

Picture 2: CUCSA Cement plant

Picture 3: Sampling place 1.

Picture 4: Sampling place 2.

Picture 5: Sampling place 3.

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