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Contamination of chicken eggs near the Bolshoi Trostenec dumpsite in Belarus by dioxins, PCBs and hexachlorobenzene

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“Keep the Promise, Eliminate POPs!” Campaign Report

Prepared by Dioxin, PCBs and Waste WG of the International POPs Elimination Network (IPEN) Secretariat, Foundation for Realization of Ideas (Belarus) and Arnika Association (Czech Republic)

Minsk - Prague (March - 24 - 2005)

Executive Summary

Free-range chicken eggs collected near the Bolshoi Trostenec dumpsite located 5 km outside Minsk. the capitol city of Belarus, showed high levels of PCBs and elevated levels of dioxins. PCBs levels expressed in WHO-TEQs exceeded background levels by more than 10-fold and were four times higher than the proposed European Union (EU) limit for eggs. Levels of dioxins exceeded EU regulatory limits for eggs by almost 1 pg WHO-TEQ/g. To our knowledge, this study represents the first data about POPs in chicken eggs from Belarus.

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. Belarus endorsed the Convention 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 Belorussian 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 Belorussian 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 Belarus is needed;

2) More publicly accessible data about U-POPs releases from all potential sources in the region are needed to address them properly; the estimates 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.

5) PCBs-containing equipment as well as all wastes should be strictly controlled and disposed by non-combustion technologies and not landfilled.

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. Belarus endorsed 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 Bolshoi Trostenec dumpsite was selected as a sampling site since open burning of PVC plastic and other chlorine-containing items are known to produce dioxins and furans as well as other U-POPs. Also, about 20 years ago, the bottom ash from the Minsk incinerator was disposed here. Waste incineration bottom ash is known to be a significant source 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 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 Belarus.

Materials and Methods

Please see Annex 1.

Results and Discussion

U-POPs in eggs sampled near the Bolshoi Trostenec dumpsite in Belarus

The results of the analysis of a pooled sample of 6 eggs collected near the Bolshoi Trostenec dumpsite are summarized in Tables 1 and 2. Pooled sample fat content was measured at 12.0%.

PCBs levels expressed in WHO-TEQs shown in Table 1 exceeded background levels by more than 10-fold and were four times higher than the proposed European Union (EU) limit for PCBs in eggs. Levels of dioxins in the pooled sample from Belarus exceeded EU regulatory limits for eggs by almost 1 pg WHO-TEQ/g. In addition, the combined levels of dioxins and PCBs in the eggs were more than two times higher than the proposed EU limit.. HCB levels in eggs from Bolshoi Trostenec exceeded background levels by almost 5-fold.

Table 1: Measured levels of POPs in eggs collected near the Bolshoi Trostenec dumpsite in Belarus per gram of fat.

	Measured level	Limits	Action level
PCDD/Fs in WHO-TEQ (pg/g)	3.63 - 3.91	3.0[a]	2.0[b]
PCBs in WHO-TEQ (pg/g)	9.83	2.0[b]	1.5[b]
Total WHO-TEQ (pg/g)	13.46 - 13.74	5.0[b]	-
PCB (7 congeners) (ng/g)	70.87	200[c]	-
HCB (ng/g)	4.70	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 the levels of U-POPs in eggs expressed as fresh weight.

Table 2: Measured levels of POPs in eggs collected near the Bolshoi Trostenec dumpsite in Belarus per gram of egg fresh weight.

	Measured level	Limits	Action level
PCDD/Fs in WHO-TEQ (pg/g)	0.43 - 0.47	1[a]	-
PCBs in WHO-TEQ (pg/g)	1.18	-	-
Total WHO-TEQ (pg/g)	1.62 - 1.65	-	-
PCBs (7 congeners) (ng/g)	8.50	-	-
HCB (ng/g)	0.56	-	-

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 Belarus. The surprisingly high-levels of U-POPs observed in the egg samples support the need for further monitoring and longer-term changes to prevent uncontrolled waste disposal as well as better control of U-POPs levels in wastes.

Comparison with other studies of eggs

We compared the levels of PCDD/Fs measured in this study in eggs from the neighborhood of the Bolshoi Trostenec dumpsite 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 dioxin levels in eggs in this study exceed background levels by more than 2-fold (0.2 - 1.2 pg WHO-TEQ/g of fat) and are comparable to eggs from localities in the Czech Republic like Usti nad Labem (many different dioxins sources in the city)[2] and/or Klatovy (obsolete pesticides stockpile).[3]

The data for eggs described in this report follow on the heels of similar studies in Slovakia released 21 March 2005[4], Kenya[5] and Czech Republic[6]. The eggs from Belarus had the highest level of PCBs in WHO-TEQ among previous reported data (see Annex 4). Only levels of PCBs measured in eggs in the pooled sample from Lysa nad Labem in Czech Republic collected near a hazardous waste incinerator and PCBs obsolete stockpile[7] were two times higher than those found in eggs from Bolshoi Trostenec.

HCB levels in eggs from Bolshoi Trostenec exceeded background levels by almost 5-fold but were lower than levels observed in samples collected from Czech Republic and Slovakia (see Annex 7.)

Other studies showing high levels of dioxins include samples near an old waste incinerator in Maincy, France [8] and an area affected by a spread mixture of waste incineration residues in Newcastle, UK.[9] The mean dioxin values observed in these locations in pooled samples were much 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 PCBs represent the most serious contaminant in the sampled eggs from the Bolshoi Trostenec dumpsite. PCBs contribute more than 70% of the whole TEQ value in eggs as visible from graph in Annex 6. Despite this substantial contribution of PCBs, levels of dioxins and HCB are not negligible as shown in Annexes 2, 3 and 7.

Because of high contribution of PCBs to WHO-TEQ levels in eggs from Bolshoi Trostenec we compared also 7 PCBs congeners (PCB 28, 52, 101, 118, 153, 138 and 180) data for these eggs with other measured levels from different parts of the world. The highest level of the 7 PCBs congeners ever measured in eggs was found in Belgian eggs during the crisis in 1999 at levels of 46,000 ng/g of fat.[10] Comparison with other data is in Annex 5.

Possible U-POPs sources

The high levels of U-POPs in free range chicken eggs in these samples provoke the question of possible sources. As already mentioned, compared to other eggs samples analyzed for U-POPs from three countries. these eggs from Bolshoi Trostenec have very high levels of PCBs in WHO-TEQ. In fact, the ratio of PCBs to PCDD/Fs is opposite compared to other published analyses of eggs from Kenya, Czech Republic (Usti nad Labem) and Slovakia (Koshice) - see Annex 6. This provokes the question of the origin of the PCBs in the eggs.

The sum of the 7 PCBs congeners in these Belorussian samples was not as high as expected. We found much higher levels in eggs from the Czech Republic and Slovakia, countries with typically high background levels and many contaminated sites by PCBs due to its production and use in many products (paintings, plasters, transformer oils).[11] Therefore, we believe that the contribution of PCBs to WHO-TEQ levels in these samples from Belarus has a by-product origin either in chemical and/or combustion processes connected with the waste dumpsite. These can include wastes from chemical processes and incineration as well as uncontrolled burning of waste at the dumpsite itself. On the other hand we can not exclude the possibility that the PCBs in the egg samples came from technical chemicals disposed of at the dump.

This pooled six-sample study supports calls for a larger monitoring study which would be focused on all U-POPs levels in homegrown food not only in the area, but all of Belarus. It also calls for more strict control of wastes disposal and for measurements of U-POPs in wastes.

The Bolshoi Trostenec dumpsite

The Trostenec landfill site is located 5 km outside Minsk to the south-east direction. This landfill site has operated since 1958. It is the oldest and largest landfill in Minsk area. The landfill presents itself a special anthropogenic body; an embankment with boards (the height of the boards is about 30 meters), with the depth of the hole at about 12 meters. This hot spot is situated on the Minsk Hills in the territory between the river Svisloch and its left tributary, the river Trostyanka. The distance between the landfill and the nearest open water reservoir (storage pond “Stayki”) is 3.0 km. The distance between the landfill and the nearest underground water source (water scoop “Drazhnya”) is 2.5 km. The direction of the underground drainage from the landfill is the south-east to the Trostyanka river. The landfill does not have waterproofing protection. The only so-called nature-protection construction is the by-pass drain across the western and southern boards. The basis of the landfill is sand and gravel.

The Trostyanka River flows across the village Bolshoi Trostenec, which was the locality for eggs sampling. The distance between the landfill and the village is 0.5-1.0 km.

Each year, more than 880 000 m^3 of wastes are disposed at the Bolshoi Trostenec landfill. This waste stream ,mainly consists of household waste, but also includes some waste from the Minsk waste processing plant, industrial waste from the varnish-and-paint industry, pharmaceutical industry waste, building waste, and other types of waste.

A considerable part of the waste stream is plastic waste. In additon, about 20 years ago, the bottom ash from the Minsk incinerator was disposed here (the incinerator was closed at the beginning of the 1990s). From the waste amount disposed in the landfill, more than 100 toxic substances get into the environment. The landfill is admittedly the source of dioxins pollution because of fires that occur frequently in the summer.

Environmental, Socioeconomic, and Health Consequences of the dumpsite

The distance between the nearest settlement, village Bolshoi Trostenec, and the landfill is less than 1 km. The area directly affected by the dump is approximately several square kilometers with a total population of several tens of thousands of people. The indirectly affected territory is much larger. The influence of the landfill on the environment is being redoubled by the influence of industrial zone Shabany, which is situated several kilometres away. This industrial zone includes the Minsk waste processing plant, water cleaning station, concrete (cement) plant, and several other plants.

The potential damage to local environment from the Trostenec dump is profound due to the large territory occupied by the landfill and the emission of toxic substances to ground water, air and soil. It is likely that this landfill also has a considerable impact on the health of the local population due to emissions of toxic substances. In addition, there is a population of homeless people who live at the dump. This population often sets the fires at the landfill resulting in more toxic emissions.

Scientific/official studies/data about the site

Several official studies of the environmental situation have been published in the past several years:

- L.D. Lebedeva, N.P. Volkova. Geoecological problems of the landfill site Trostenec of Minsk. Natural Resources # 3, pp. 46-53. 2003, Minsk.

- § A.V. Kudel’skii et al. Material composition and ecotoxicological danger of household landfill sites. Reports of National Academy of Sciences of Belarus, 2001. Volume 45, # 6, pp. 90-96
- § N.V. Koval’chik. Landscape-geological basing of placing of landfills on the territory of Belarus. Ph.D. thesis. Minsk, 2000. 203 pages.

Also, a system of the environmental monitoring was implemented at the Trostenec landfill site. It monitors the concentration of heavy metals, some salts, several organic compounds and landfill gases, i.e. methane. Unfortunately, POPs are not included in the monitoring. In addition, there were no investigations of POPs concentrations in the area of the landfill and its surrounding territory.

Among the other toxic chemicals that are present in the local environment, it is necessary to mention organic compounds in soils/wastes (i.e. benzo-(a)-pyren: 51.69 - 235.45 ug/kg, naphthalene: 26 - 1143.9 ug/kg, anthracene and other compounds). These substances migrate easily from the landfill into the ground water and travel further to the local landscape. There are no special health studies that have been conducted in the territory around the landfill.

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. Belarus endorsed the Convention in February 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.[1] 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).[2] In addition, Parties are to promote both BAT and best environmental practices (BEP) for all new and existing significant source categories,[3] 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.[4] 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 Belorussian 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 Belorussian governmental representatives and all stakeholders to honor the integrity of the Convention text and keep the promise of reduction and elimination of POPs.

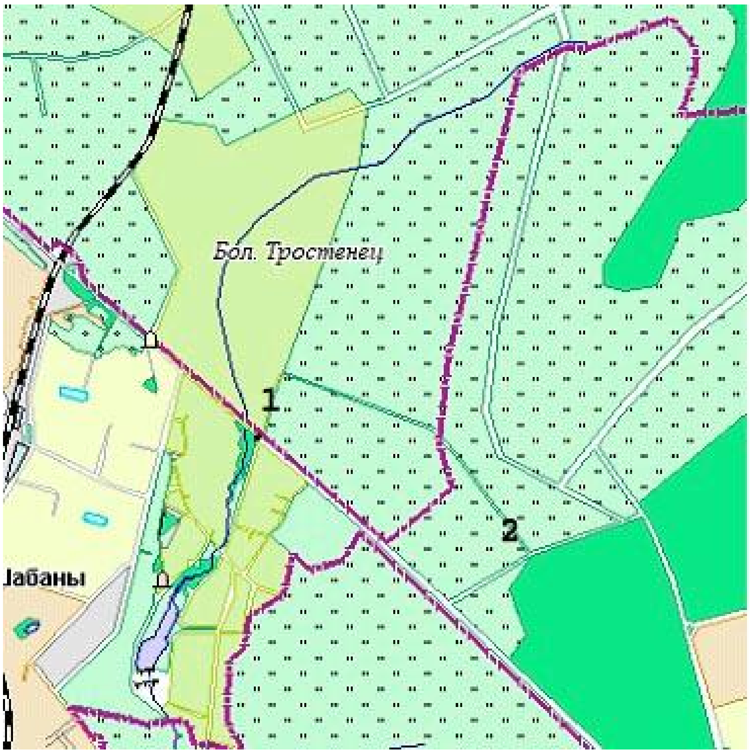
[1] Article 5, paragraph (c)
[2] Article 5, paragraph (d)
[3] Article 5, paragraphs (d) & (e)
[4] Article 5, paragraph (a), subparagraph (i)

Annex 1. Materials and Methods

Sampling

For sampling in Belarus we have chosen the neighborhood of the dumpsite in Bolshoi Trostenec, 5 km southeast from Minsk, the capitol of the country. The eggs were collected from two chicken fanciers in 0.5 - 1 km distance from the landfill. The hens from which the eggs were picked were between 1.5 and 2 years old, and were all free-range although provided with local hay, local nettle, barley and bread. The hens can easily access soil organisms and freely roam over an area of 250 square meters.

Sampling was done by members of Foundation for Realization of Ideas on 9 January 2005. Two chicken fanciers supplied 10 eggs from their free range chickens. The eggs were kept in cool conditions after sampling and then were boiled in Belarus by Foundation for Realization of Ideas for 7 - 10 minutes in pure water and transported by express service to the laboratory at ambient temperature.



Map of the sampling place and hot spot place

1 -- Eggs sampling place in the village Bolshoi Trostenec;
2 -- Location of the landfill site Trostenec.

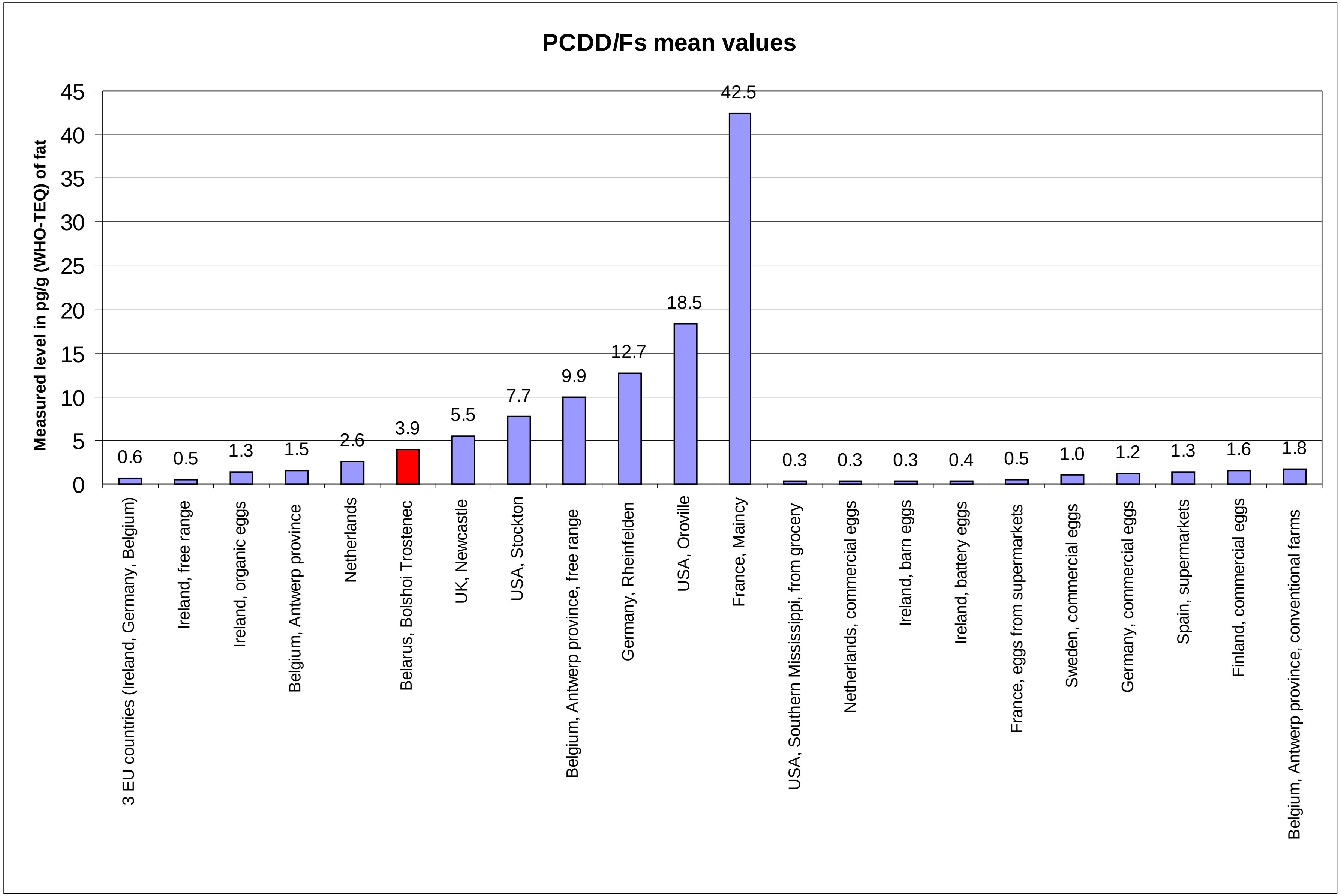
Analysis

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.[1] 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.

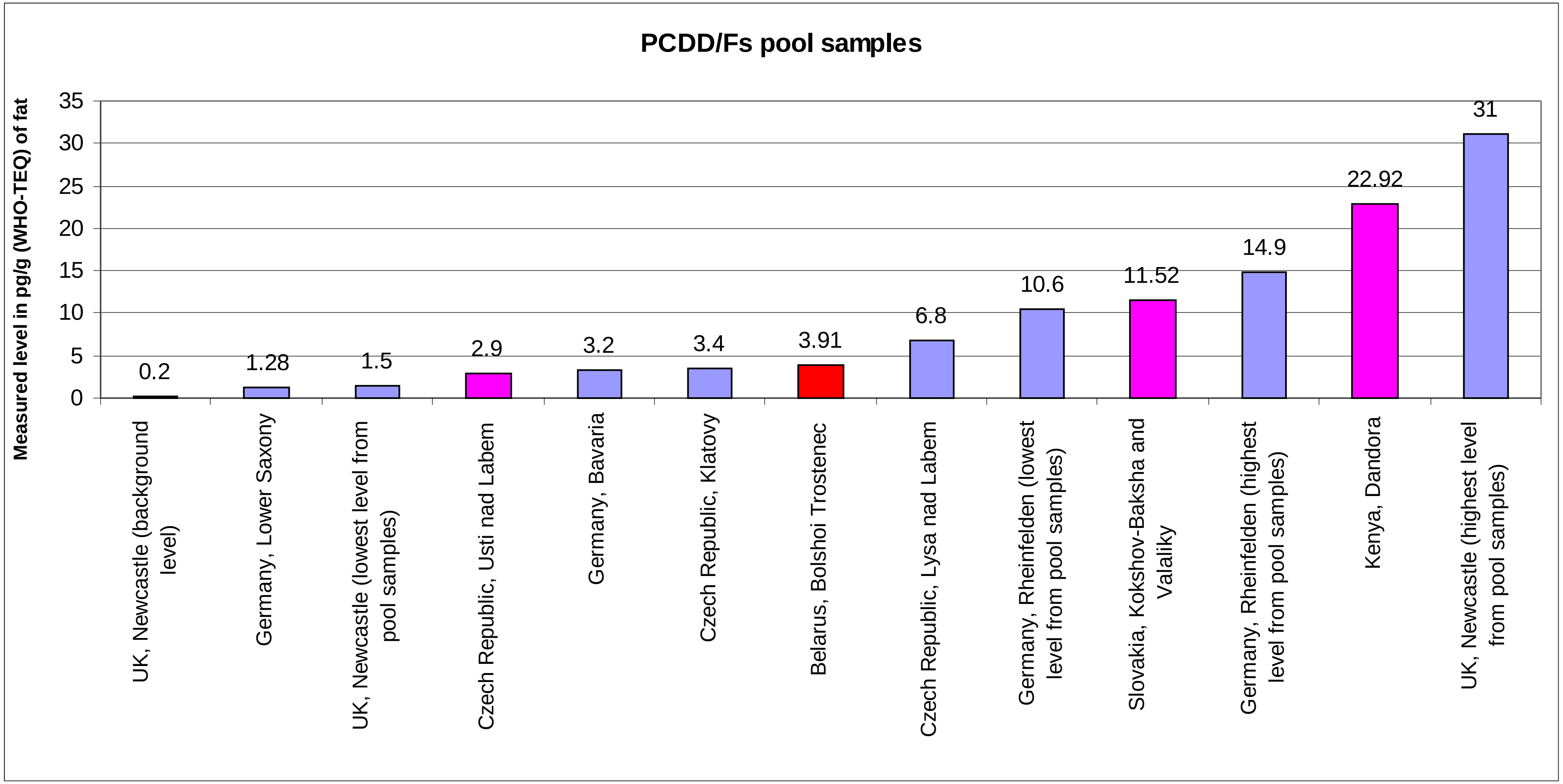
Annex 2: Mean values found within different groups of eggs from different parts of world

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	1,30	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
Belarus, Bolshoi Trostenec	2005	free range	3,91	Axys Varilab 2005
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
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
3.9
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
Netherlands
Belarus, Bolshoi Trostenec
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

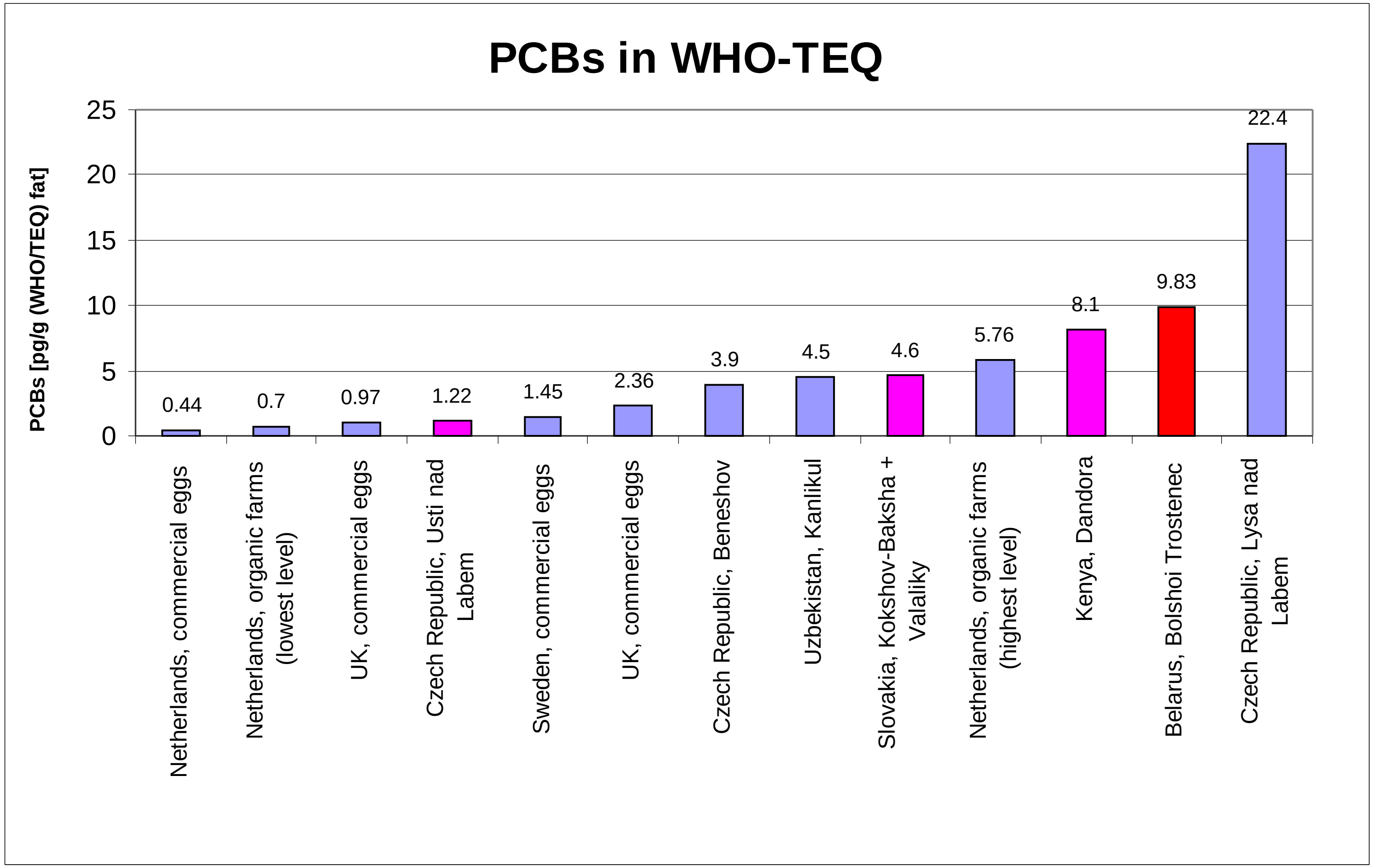
Annex 3: Levels of dioxins (PCDD/Fs) in different pool samples from different parts of world

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	0.20	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
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
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, 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)
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

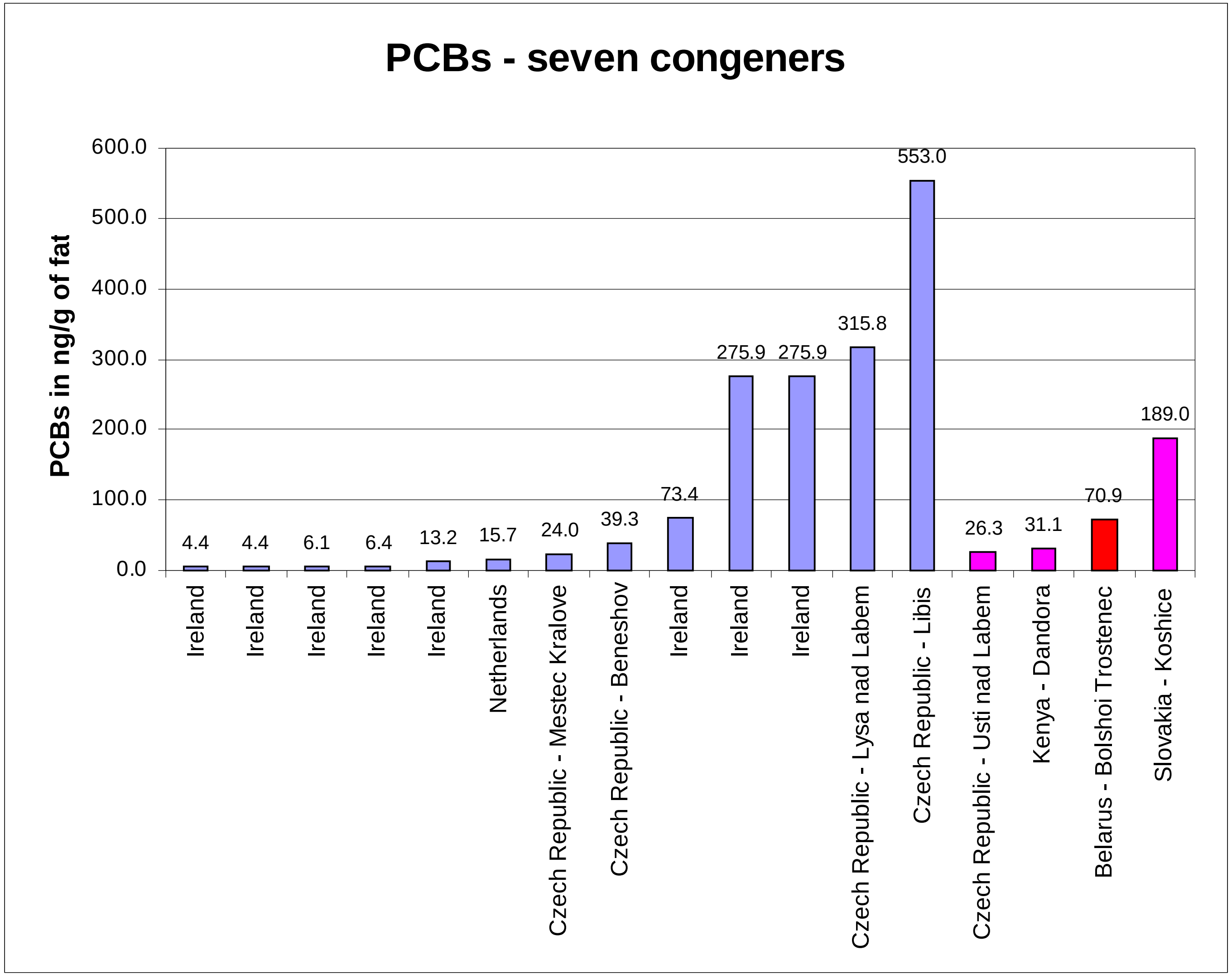
Country/locality	Year	Group	Number of measured samples	Specification	Measured level in pg/g (WHO-TEQ) of fat	Source of information
Netherlands, commercial eggs	1999	not free range	100/2 pools	pool, nonortho-PCBs	0.44	SCOOP Task 2000
Netherlands, organic farms (lowest level)	2002	free range	6	pool	0.70	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
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
9.83
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
Belarus, Bolshoi Trostenec
Czech Republic, Lysa nad Labem

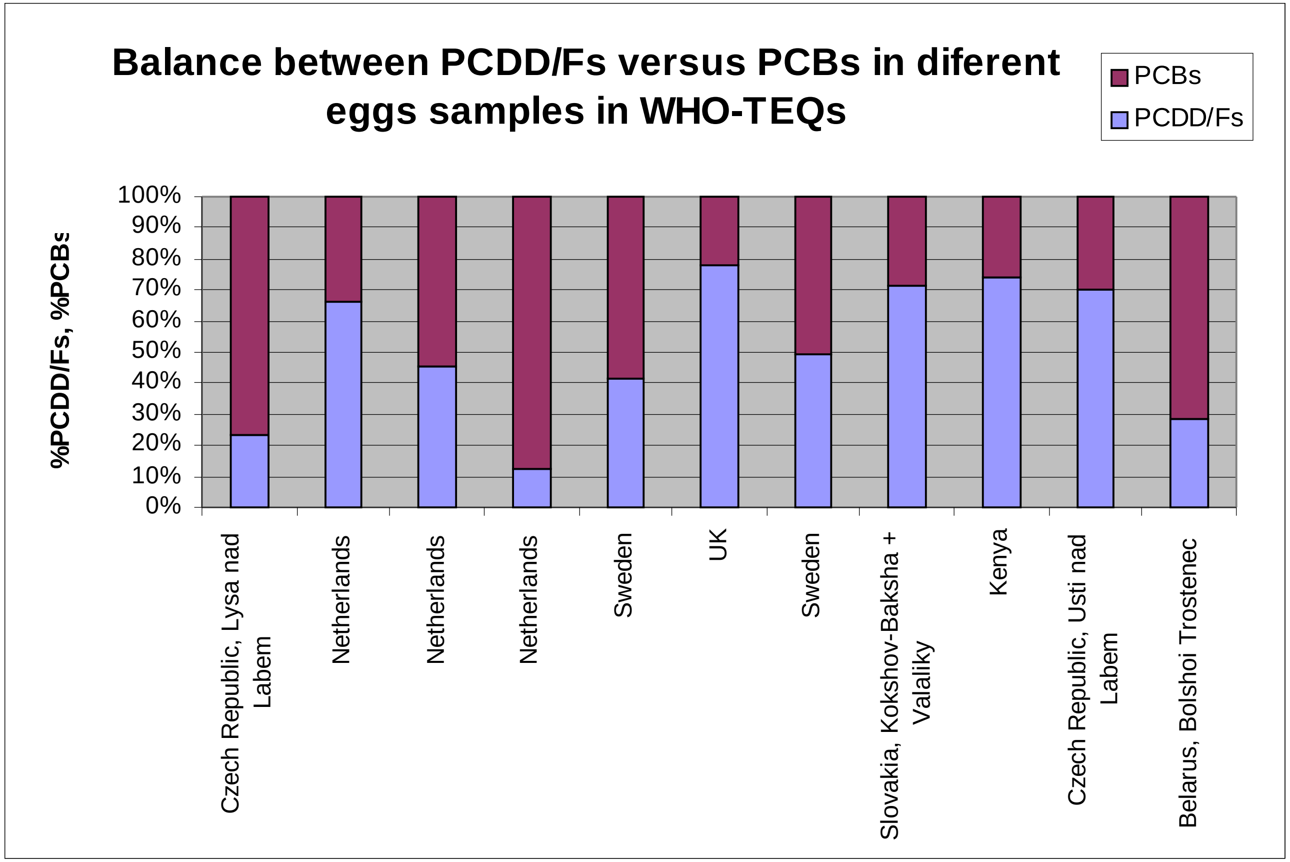
Annex 5: Levels of seven PCBs congeners in different chicken eggs samples from different parts of world

Country	Specification	Measured level in ng/g fat	Date/year	Source of information	Notes:
Ireland	FR	4.4	2002-2005	Pratt, I. et al. 2004, FSAI 2004	BE - barn eggs
Ireland	BE	4.4	2002-2005	Pratt, I. et al. 2004, FSAI 2004	BTE - battery eggs
Ireland	BTE	6.1	2002-2005	Pratt, I. et al. 2004, FSAI 2004	FR - free range
Ireland	OE	6.4	2002-2005	Pratt, I. et al. 2004, FSAI 2004	NS - not specified
Ireland	OE	13.2	2002-2005	Pratt, I. et al. 2004, FSAI 2004	OE - organic eggs
Netherlands	NS	15.7	1998-1999	Baars, A. J. et al. 2004	EMN - eggs melange - nonpastorized
Czech Republic - Mestec Kralove	EMN	24.0	14.10.2003	SVA CR 2004	
Czech Republic - Beneshov	FR	39.3	2004	Axys Varilab 2004	
Ireland	OE	73.4	2002-2005	Pratt, I. et al. 2004, FSAI 2004	
Ireland	OE	275.9	2002-2005	Pratt, I. et al. 2004, FSAI 2004	
Ireland	OE	275.9	2002-2005	Pratt, I. et al. 2004, FSAI 2004	
Czech Republic - Lysa nad Labem	FR	315.8	2004	Petrlik, J. 2005	
Czech Republic - Libis	NS	553.0	2003	Holejsovsky 2003	
Czech Republic - Usti nad Labem	FR	26.3	2005	Axys Varilab 2005	
Kenya - Dandora	FR	31.1	2004	Axys Varilab 2005	
Belarus - Bolshoi Trostenec	FR	70.9	2005	Axys Varilab 2005	
Slovakia - Kokshov-Baksha	FR	189.0	2005	Axys Varilab 2005	


PCBs - seven congeners
PCBs in ng/g of fat
600.0
500.0
400.0
300.0
200.0
100.0
0.0
4.4
4.4
6.1
6.4
13.2
15.7
24.0
39.3
73.4
275.9
275.9
315.8
553.0
26.3
31.1
70.9
189.0
Ireland
Ireland
Ireland
Ireland
Ireland
Netherlands
Czech Republic - Mestec Kralove
Czech Republic - Beneshov
Ireland
Ireland
Ireland
Czech Republic - Lysa nad Labem
Czech Republic - Libis
Czech Republic - Usti nad Labem
Kenya - Dandora
Belarus - Bolshoi Trostenec
Slovakia - Koshice

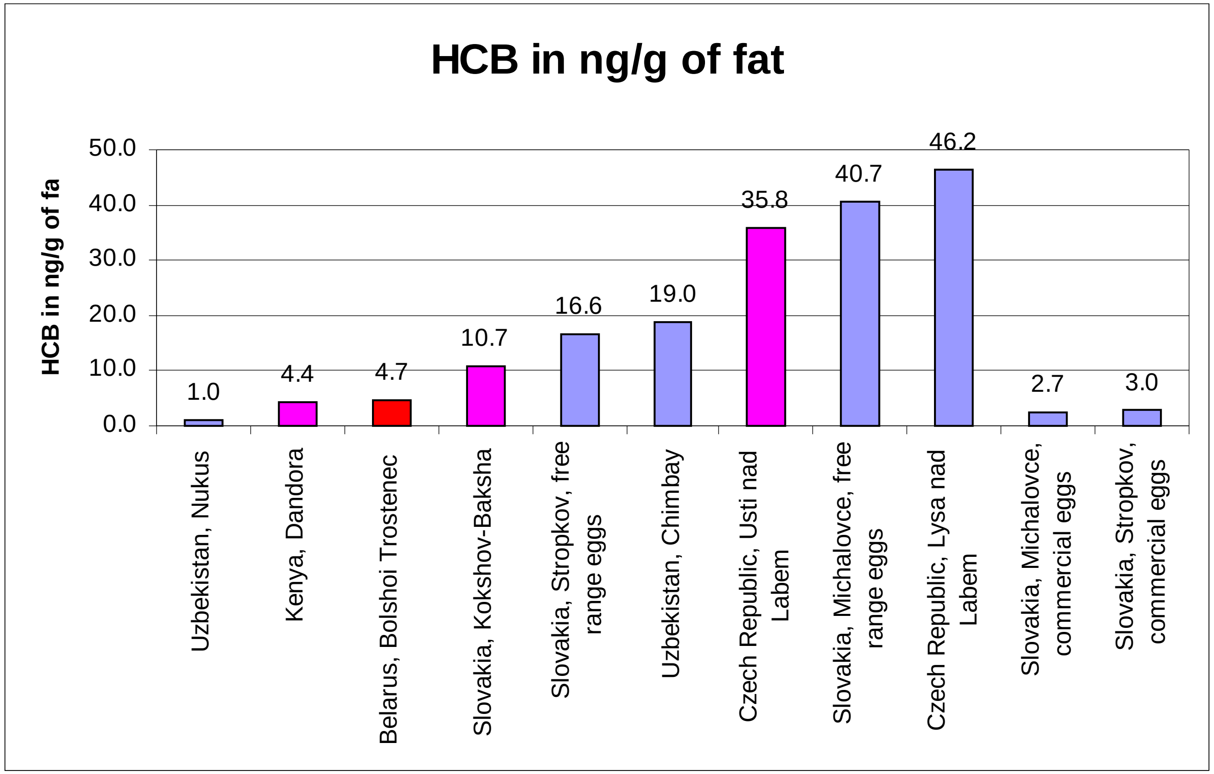
Annex 6: Balance between PCDD/Fs versus PCBs in diferent eggs samples in WHO-TEQs

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 + Valaliky	2005	free range	11.52	4.60	16.12	Axys Varilab 2005
Kenya	2004	free range	22.92	8.10	31.02	Axys Varilab 2005
Czech Republic, Usti nad Labem	2005	free range	2.90	1.22	4.12	Axys Varilab 2005
Belarus, Bolshoi Trostenec	2005	free range	3.91	9.83	13.74	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, Bolshoi Trostenec

Annex 7: 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
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
4.4
4.7
10.7
16.6
19.0
35.8
40.7
46.2
2.7
3.0
Uzbekistan, Nukus
Kenya, Dandora
Belarus, Bolshoi 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 8: Photos

Picture 1: Chickenfancier Faina Golovachko and activist of FRI Maryna Karavai during the eggs sampling. Photo by: © Eugeniy Lobanov/FRI

Picture 2: Foraging chicken at the sampling location. Photo by: © Eugeniy Lobanov/FRI.

Picture 3: Sight on landfill Trostenec from the sampling place in the village Bolshoi Trostenec. Photo by: © Eugeniy Lobanov/FRI

Picture 4: Fire at the landfill Trostenec. Photo by: © Vasily Mazaev/FRI.

Picture 5: At the dumpsite Trostenec. Photo by: © Vasily Mazaev/FRI.

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