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Contamination of chicken eggs from Helwan in Egypt 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, Day Hospital Institute (Egypt) and Arnika Association (Czech Republic)

(Photo at cover page: Paul Lancaster)

Cairo - Prague - 15 April 2005

Executive Summary

The free-range chicken eggs collected in Helwan showed one of the highest levels of dioxins ever measured in chicken eggs. In fact, to our knowledge, they showed the third highest level of dioxins in eggs ever documented. Dioxins in eggs from Helwan exceeded the European Union (EU) limit by more than 40-fold. The level of PCBs in the eggs exceeded the proposed EU limit by almost 5-fold. In addition, significant levels of HCB were also observed. To our knowledge, this study represents the first data about U-POPs in chicken eggs from Egypt.

Potential existing dioxin sources in Helwan include: the metallurgical industry, uncontrolled burning of the wastes and/or cement kilns. Since the pattern of dioxins in eggs was dominated by furans (PCDF), it is likely that the sources came mainly from combustion. One clue about the possible source is revealed by comparing the data in this study with data from Korea. The dioxin congener pattern for the metallurgy industry (steel as well as lead production) in Korea is similar to the pattern observed in this study from Helwan..[1, 2] This suggests that the steel industry is a significant source of dioxins seen here, though other combustion sources cannot be excluded.

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. Egypt is a Party to Convention since it ratified the Treaty in May 2003. 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 Egyptian 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 Egyptian 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) More POPs monitoring in Egypt is needed as even basic data about U-POPs releases are missing;

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

3) Stringent limits for U-POPs in waste as well as air emissions should be introduced into both national legislation and under international treaties.

4) The Helwan region needs to be addressed specifically as a large source of industrial pollution including POPs.

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. Egypt ratified the Convention in May 2003.

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 Helwan region in Egypt was selected as a sampling site since the metallurgical industry and other combustion sources concentrated in the city are known to be a significant sources of unintentionally produced POPs.[3] 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 in Egypt.

Materials and Methods

Please see Annex 1.

Results and Discussion

U-POPs in eggs sampled in Helwan, Egypt

The results of the analysis of a pooled sample of 6 eggs collected within to 2 km distance from the metallurgy facility in Helwan are summarized in Tables 1 and 2. Pooled sample fat content was measured at 14.0%.

Free-range chicken eggs collected in Helwan showed one the highest levels of dioxins ever measured in chicken eggs - the third highest level as far as we know. Dioxins in eggs from Helwan exceeded the European Union (EU) limit by more than 40-fold. The level of PCBs in eggs exceeded the proposed EU limit by almost 5 fold. The level of HCB was also significant since it exceeds the newly proposed EU limit for HCB as a pesticides residue in eggs. To our knowledge, this study represents the first data about U-POPs in chicken eggs from Egypt.

Table 1: Measured levels of POPs in eggs collected near the metallurgy facility in Helwan, Egypt per gram of fat.

	Measured level	Limits	Action level
PCDD/Fs in WHO-TEQ (pg/g)	125.78	3.0[a]	2.0 [b]
PCBs in WHO-TEQ (pg/g)	11.74	2.0 [b]	1.5 [b]
Total WHO-TEQ (pg/g)	137.52	5.0 [b]	-
PCB (7 congeners) (ng/g)	6.80	200 [c]	-
HCB (ng/g)	15.10	200[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.

Table 2 shows that the level of dioxins in eggs expressed as fresh weight exceeded the limit for commercial eggs in the USA by almost 18-fold. The US Food and Drug Administration estimates a lifetime excess cancer risk of one per 10,000 for eggs contaminated at 1 pg/g ITEQ. The samples collected in Helwan exceeded this cancer risk level.[a]

Table 2: Measured levels of POPs in eggs collected near the metallurgy facility in Helwan, Egypt per gram of egg fresh weight.

	Measured level	Limits	Action level
PCDD/Fs in WHO-TEQ (pg/g)	17.61	1[a]	-
PCBs in WHO-TEQ (pg/g)	1.64	-	-
Total WHO-TEQ (pg/g)	18.97	-	-
PCBs (7 congeners) (ng/g)	0.95		
HCB (ng/g)	2.11	-	-

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 Egypt. The levels of dioxins, HCB and PCBs exceeding the EU limits observed in the egg samples support the need for further monitoring and longer-term changes to eliminate chlorinated chemicals that serve as donors for the U-POPs listed under the Stockholm Convention thus far.. These data indicate the need for a proper Toolkit to help develop a realistic inventory of national U-POPs releases that includes all U-POPs and better reflects the actual situations in developing countries.

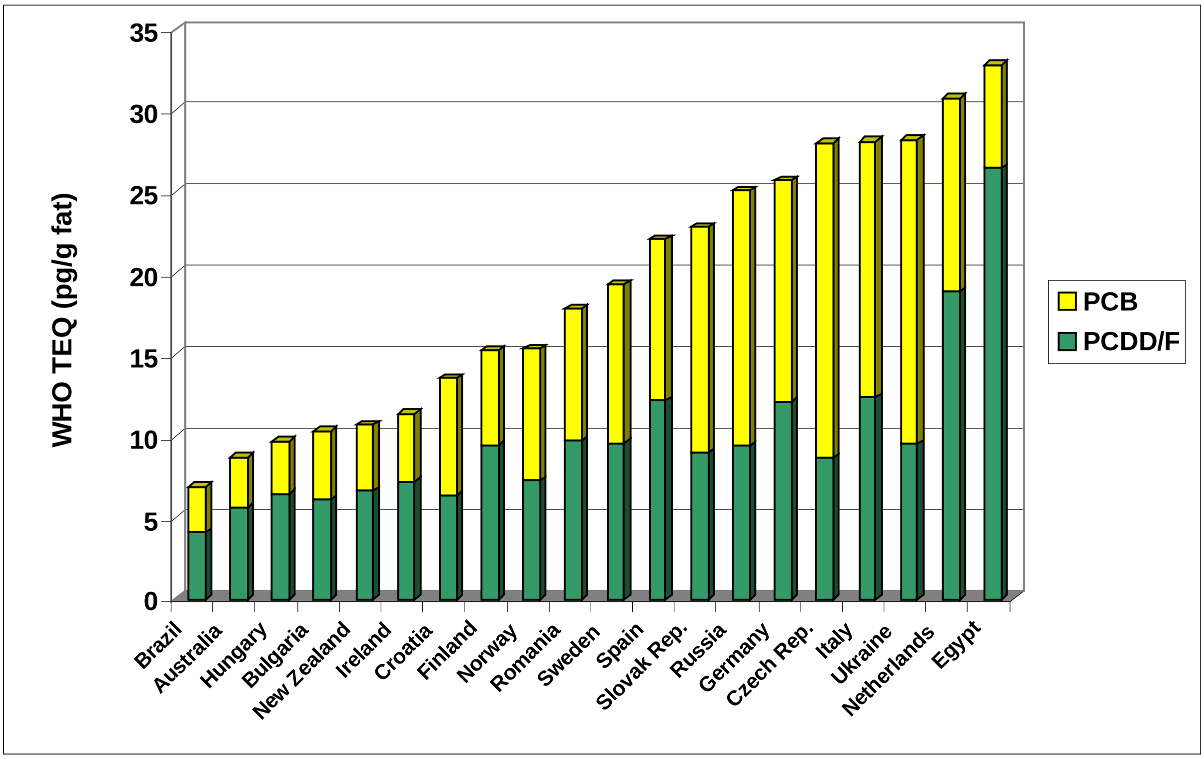
[a] was estimated (using a cancer potency factor of 130 (mg/kg-day)-1 and rounding the risk to an order of magnitude) for consumption of 3-4 eggs per week (30 g egg/day) contaminated at 1 ppt I-TEQ[a, a]

Comparison with other studies of eggs

We compared the levels of PCDD/Fs measured in this study in eggs from Helwan 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 a similar studies in Slovakia,[4] Kenya,[5] Czech Republic,[6] Belarus,[7] India (Uttar Pradesh),[8] Tanzania,[9] Senegal,[10] Uruguay,[11] Mexico [12] and Turkey[13] released since 21 March 2005. Dioxins levels in the eggs sampled from Helwan are much higher than any of those presented in previous reports prepared as a part of the IPEN study of U-POPs in eggs. To compare the data please see Annex 3. We also compared the measured dioxin levels in this study with maximum levels found so far in chicken eggs within different groups of chicken eggs around the world (see Annex 4).

A comparison of the Helwan eggs measured here with other highly contaminated eggs shows that these eggs are the third most dioxin-polluted eggs ever measured. The highest dioxin levels in eggs were observed in Belgium (713.1 pg WHO-TEQ/g) at the time of the Belgian scandal with dioxins in chickens in 1999.[14] The second highest level found in the literature was measured in Rheinfelden in 1992 within the area contaminated by chemical production (514 pg WHO-TEQ/g of fat).[15] Very close to level of dioxins in eggs from Helwan is the level found in neighborhood of an old waste incinerator in Maincy (France) shut down in 2002 (121.55 pg WHO-TEQ/g).[16]

Picture 1: Graph showing results of the WHO 3rd round of measurement of PCDD/Fs and PCBs in breast milk.[17]



It is clear that dioxins represent the most serious contaminant in the sampled eggs from the Helwan region. PCDD/Fs contribute more than 90% of the whole TEQ value in eggs as visible from graph in Annex 6. Despite this substantial contribution of dioxins, levels of PCBs and HCB are not negligible as shown in Annexes 5 and 7. Levels of PCBs are lower than that those found in eggs from Lysa nad Labem in the Czech Republic,[18] but are higher than in eggs from Bolshoi Trostenec in Belarus (dumpsite area)[19] and/or in Lucknow in India (city with several medical waste incinerators).[20] HCB in eggs from Helwan exceeds the background levels (1 ng/g of fat) by almost 15-fold (see Annex 7). The sum of the seven congeners of PCBs was very low compared to other countries.[21]

Findings of high levels of dioxins as well as the balance between PCDD/Fs versus PCBs in eggs are in good agreement with high levels of dioxins in breast milk in Egypt during the WHO 3rd round of measurements of PCDD/Fs and PCBs in breast milk worldwide. A comparison with other countries is shown in Picture 1.

Possible U-POPs sources

The extraordinarily 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, PCBs and HCB as by-products within the Helwan area.

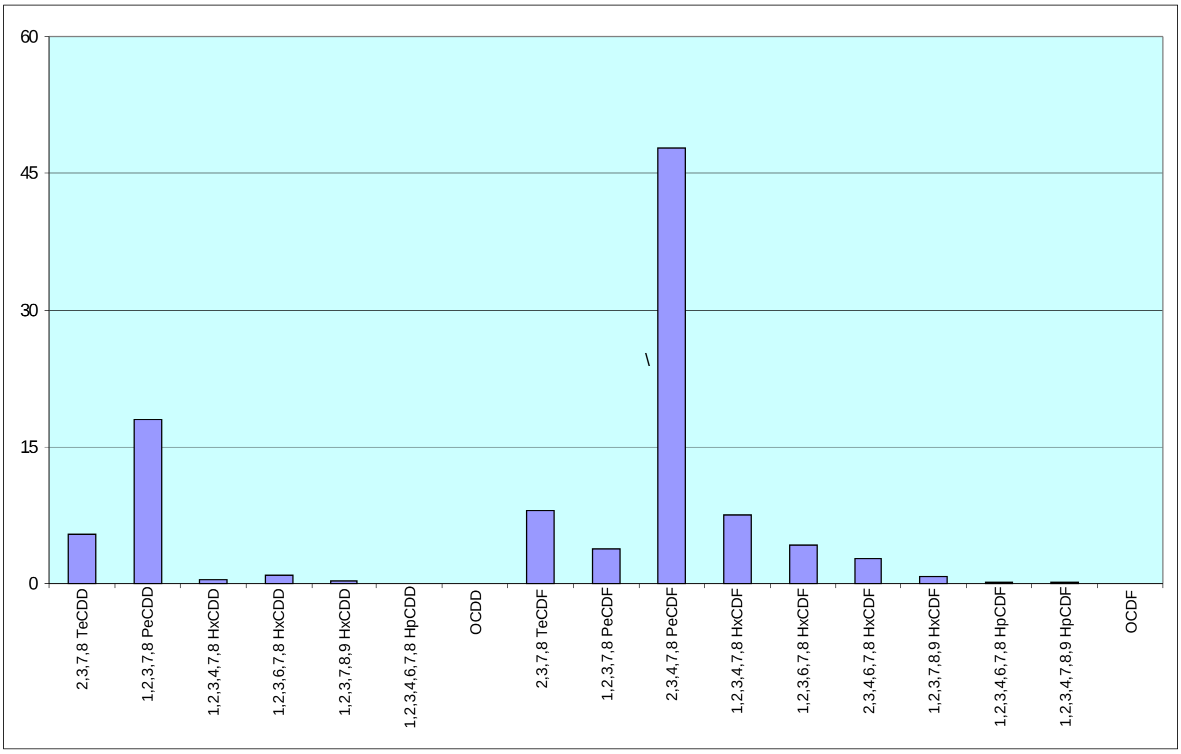
The nearest potential U-POPs sources to the sampling site are primary steel production, a cement kiln and coke plant (4 km from sampling place). There are more potential U-POPs sources located in the area including nonferrous metals production and open burning of waste for example (see following chapter).

Table 3: Results of PCDD/Fs analysis in a pooled sample of eggs collected in Helwan, Egypt

PCDD/Fs congeners	WHO-TEF	pg/g of fat	pg W-TEQ/g of fat
2,3,7,8 TeCDD	1	6.80	6.8
1,2,3,7,8 PeCDD	1	22.60	22.6
1,2,3,4,7,8 HxCDD	0.1	6.30	0.63
1,2,3,6,7,8 HxCDD	0.1	10.80	1.08
1,2,3,7,8,9 HxCDD	0.1	4.60	0.46
1,2,3,4,6,7,8 HpCDD	0.01	7.10	0.071
OCDD	0.0001	10.90	0.00109
2,3,7,8 TeCDF	0.1	100.00	10
1,2,3,7,8 PeCDF	0.05	93.20	4.66
2,3,4,7,8 PeCDF	0.5	120.00	60
1,2,3,4,7,8 HxCDF	0.1	94.90	9.49
1,2,3,6,7,8 HxCDF	0.1	53.70	5.37
2,3,4,6,7,8 HxCDF	0.1	33.70	3.37
1,2,3,7,8,9 HxCDF	0.1	9.70	0.97
1,2,3,4,6,7,8 HpCDF	0.01	17.10	0.171
1,2,3,4,7,8,9 HpCDF	0.01	11.00	0.11
OCDF	0.0001	5.70	0.00057
Total WHO-TEQ			**125.78**

Tracking the source of dioxins in eggs can be aided by comparing the pattern of congeners in the samples with that of air emissions from the sources. Unfortunately, dioxin air emission measurements from all potential sources are not available.. However, the congener pattern observed in the eggs from this site in Egypt is dominated by PCDFs, in particular TeCDF, PeCDFs, and HxCDFs.. This is quite different from the congener patterns of the other chicken eggs samples analyzed within the IPEN global project (see Annex 8). All 17 measured PCDD/Fs congeners levels are shown in Table 3. Graph 2 shows the percent contribution of each congener to the total PCDD/F content of the eggs, expressed in WHO-TEQs. Comparing the congener pattern observed here with data measured for sources such as Korean metal production facilities (steel as well as lead production) indicates metal production is one of the very likely sources of dioxins found in the eggs.[22, 23, 24] Other combustion sources such as open burning of waste or illegal waste co-incineration cannot be excluded as contributors to the contamination.

Picture 2: PCDD/Fs in eggs from Helwan – percent contribution to total WHO-TEQ of each congener



The results obtained from the analysis of this pooled sample of six eggs attests to the need for immediate action to identify the dioxin sources and eliminate or reduce their releases as well as the need for a larger monitoring study of all U-POPs levels in the environment of the Helwan region and Egypt in general.

Much information about toxic chemicals releases is either not publicly accessible or not known. For example, U-POPs releases are not measured in their full complexity in Egypt.

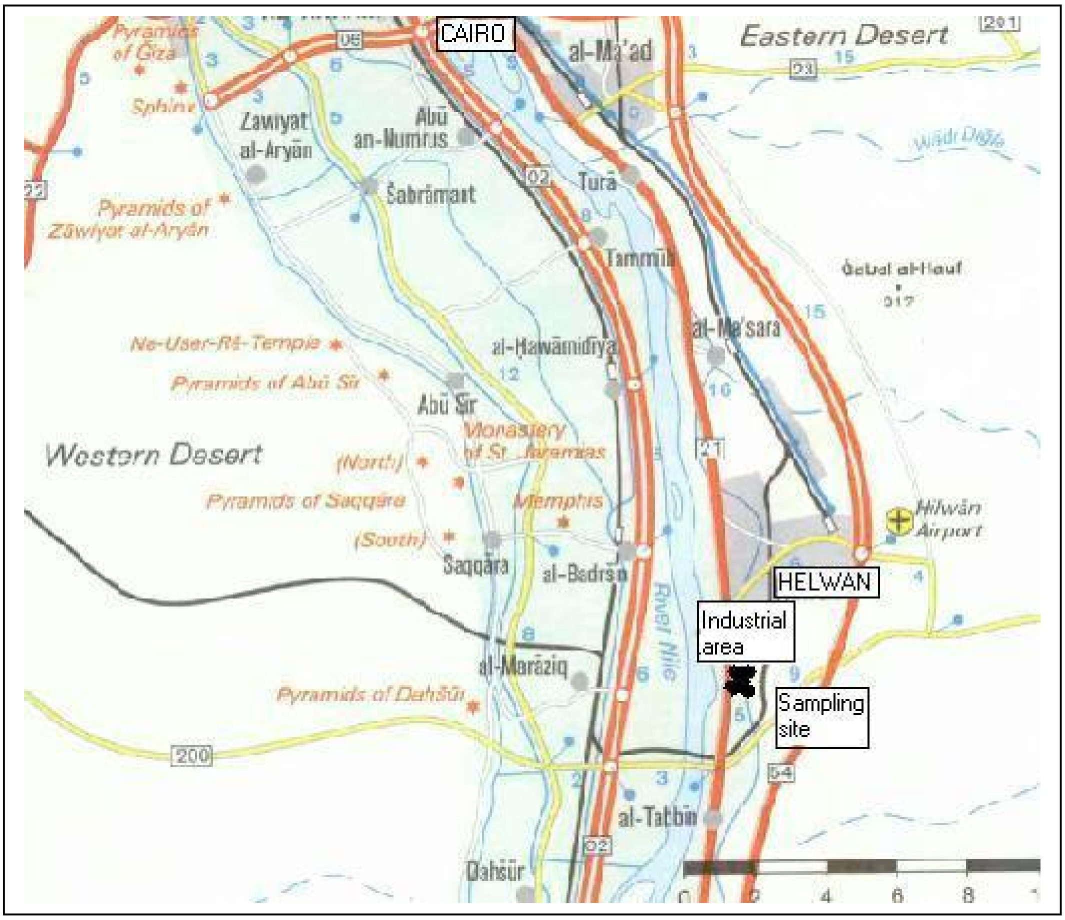
More information about the Helwan region

Helwan is one of the biggest industrial areas in Egypt and is located in the extreme south of Cairo governorate at 50˚, 29˚ North, and at 20˚, 31˚ East at the River Nile (see map at Picture 3). Helwan is also one of the great residential areas related to the Cairo governorate from south at boarders between Cairo and Giza governorates. The current population count (2003) is about 652,000. The population has increased due to the building of factories. The Helwan industrial area is restricted to 40 kilometer southern Cairo, and the industries concentrate in southern Helwan more than in the north. The Helwan region produces about 300 tons/day wastes.

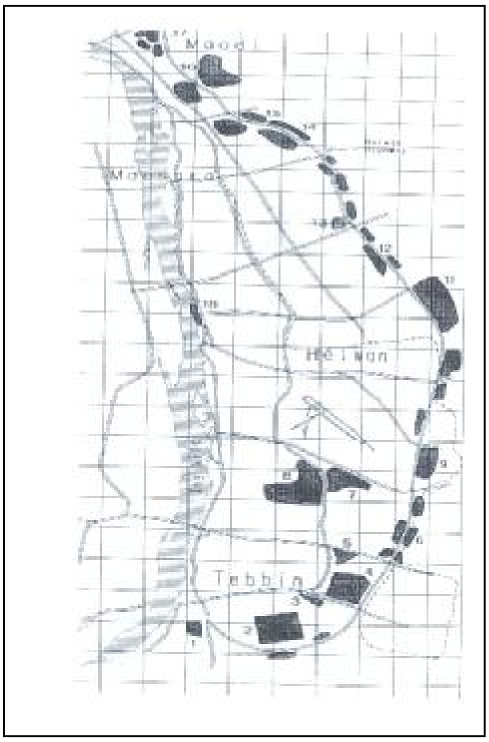
Large quantities of waste are produced per capita in Helwan (see map at Picture 4a). In addition, Helwan lacks a sustainable solid waste management plan. Open burning can be one of the significant sources of dioxins within the city.

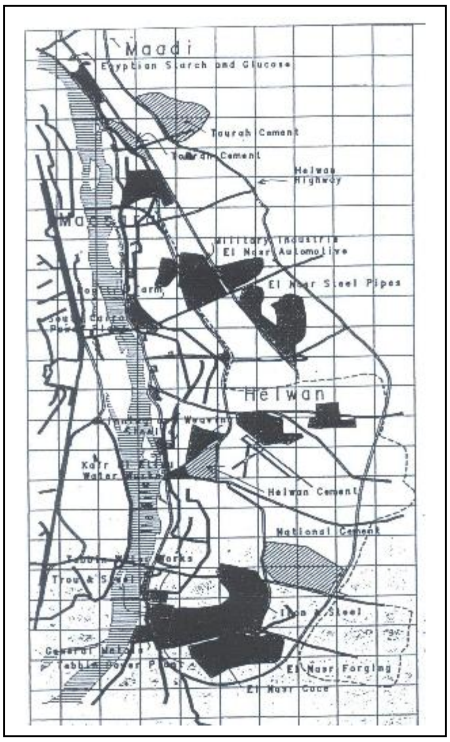
There are three cement companies in Helwan: ASEC Cement Co. SAE, Tura company and El-Kawmya company for cement. All three together have capacity for production of almost 8 million tons of cement per year.

Picture 3: Map of the city Helwan and surrounding with marked sampling site south from Helwan (marked with “X”).



Pictures 4a and 4b: Left map: solid waste dumpsites in Helwan. Right map: Industries in Helwan; black areas = non-cement industry, metallurgy, coke, chemical; shadow areas = 3 cement kilns in Helwan. Most south black spot is El Nasr Coke and





There are 90 companies and workshops in Helwan, about 26% public sector and the rest are private sector companies that involve small facilities working in metals, marble, granite and other activities. All of them contribute to pollution in the Helwan region. Besides cement production and metallurgy the most important industries in Helwan are coal, chemical industry including fertilizers, coal-tar phenols and benzol, thermal, iron and steel, hammered, vehicle and buses industry, asbestos pipe, and starch and glucose industries.

Listed below are the major industrial establishments in the area (source El Danaf, A. 2000):[25]

Factories at North Helwan

1. Egyptian Starch and Glucose Company.
2. Toura Portland Cement Company.
3. The Egyptian Telephone Company.
4. Military Factory No.45 (Massara Co. for Eng. Indust.).
5. The Egyptian Company for Pipes and Cement Products.
6. El-Nasr Automobile Manufacturing Company.
7. The Egyptian Transportation Co.
8. Cairo South Power Station.
9. El-Nasr Steel Pipes and Fittings Company.
10. Lasociete General Egyptienne De Material De Chemins De Fer (Semaf)
11. Military Factory No. 99.
12. Military Factory No.9 (Helwan Iron Foundries).
13. Military Factory No 99 (Machine Tools).
14. Military Factory No 909 (Helwan Diesel Engine Co.)
15. Military Factory No 63 (Non Ferrous Metals Co.).
16. Galvanizing Factory (ZINC Coating).

Factories at South Helwan :

1. Misr Company For Equipment of Spinning and Weaving.
2. Helwan Spinning and Weaving Co.
3. Steelco Company
4. Helwan Portland Cement Company
5. Military Factory No. 360.
6. Military Factory No 36 (Aircraft Factory).
7. Military factory No 135 (Engine Factroy).
8. Helwan Cement Co.
9. National Cement Company
10. Egyptian Iron & Steel Company
11. El-Tabbin Power Station
12. Prefabricated Houses Company
13. EGYCO.
14. South Cairo Flour Mill.
15. EGYPAC.
16. General Metal Company
17. (Chemical Fertilizer Plant).
18. (El-Nasr Co. For Coke and Chemicals) Combined.
19. EL-Nasr Forging industry.

A number of the factories listed earlier are not connected to the sewerage network and discharge their effluent directly to the river, to agricultural drains or to lagoons in the desert. Here, it should be noted that 3 factories out of the investigated 30 factories are expected to discharge 70% of the amount of industrial wastewater in the year 2000. The three factories are the Egyptian Iron and Steel company, Spinning and Weaving Company and El-Nasr Coke and Chemical Company. There are some metal processing industries in the area which discharge untreated effluent containing cyanide, chromium (IV) , zinc and other trace metals. The food processing industry in the area discharges effluent with high concentration of organic biodegradable materials including plant oil. [26]

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. Egypt ratified the Convention in May 2003.

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 Egyptian 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 Egyptian governmental representatives and all stakeholders to honor the integrity of the Convention text and keep the promise of reduction and elimination of POPs.

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[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 Egypt we have chosen the very industrialized city of Helwan. Eggs were sampled from a family that raises chickens in their backyard approximately 2 km south from a cement kiln, primary steel production facility and 4 km far from the coke plant. The hens from which the eggs were picked were all free-range although occasionally provided with local food. The hens can easily access soil organisms. The range covered by chickens was 100 square meters.

Sampling was done by Mr. Abdul Hakim from Day Hospital Institute at 27 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 Day Hospital Institute in Cairo (Egypt) for 7 - 10 minutes in pure water and transported by express service to the laboratory at ambient temperature.

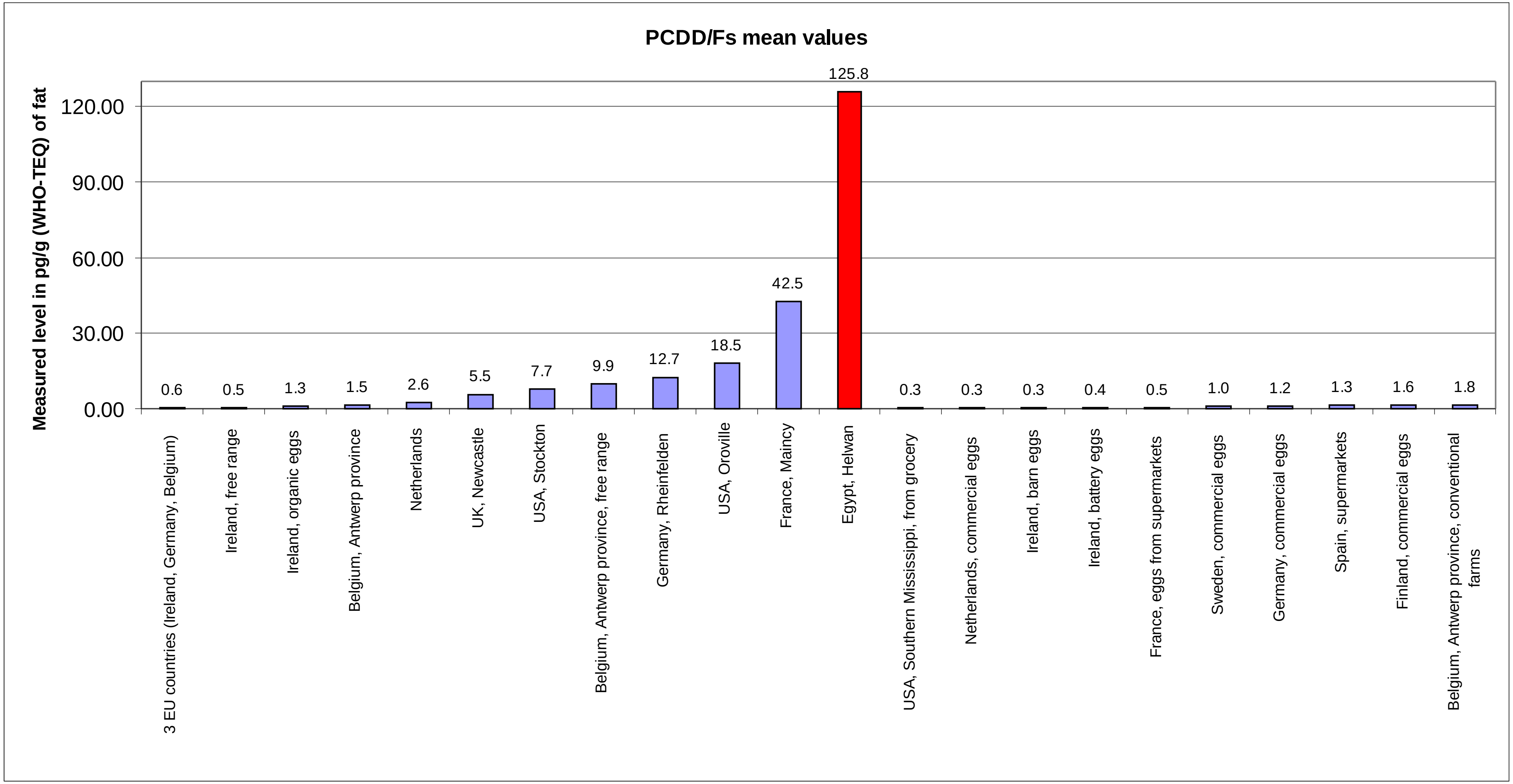
Analysis

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..

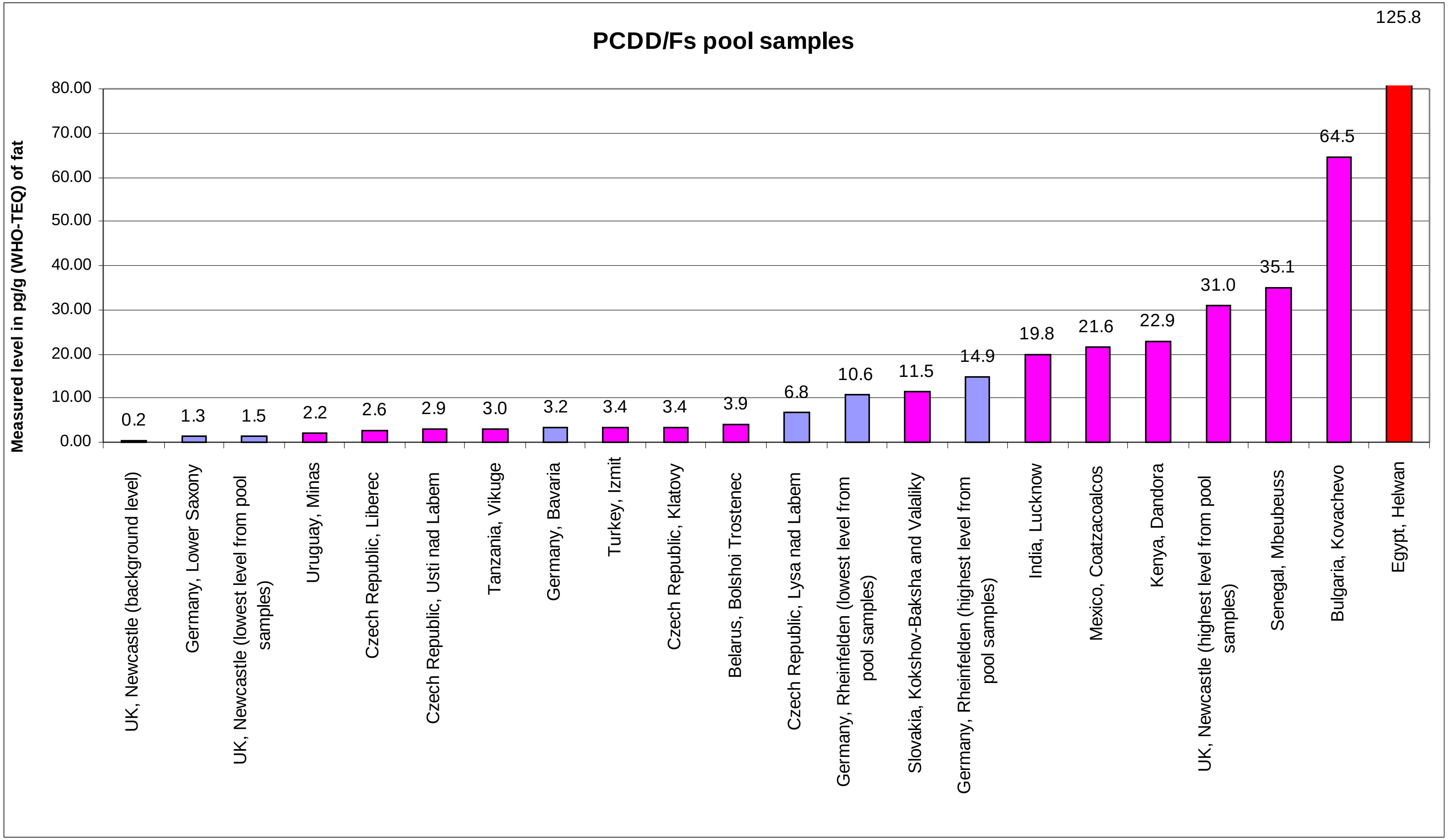
Annex 2: Mean values found within different groups of eggs from different parts of world

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
France, Maincy	2004	free range	42.47	Pirard, C. et al. 2004
Egypt, Helwan	2005	free range	125.78	Axys Varilab 2005
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
120.00
90.00
60.00
30.00
0.00
0.6
0.5
1.3
1.5
2.6
5.5
7.7
9.9
12.7
18.5
42.5
125.8
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
UK, Newcastle
USA, Stockton
Belgium, Antwerp province, free range
Germany, Rheinfelden
USA, Oroville
France, Maincy
Egypt, Helwan
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

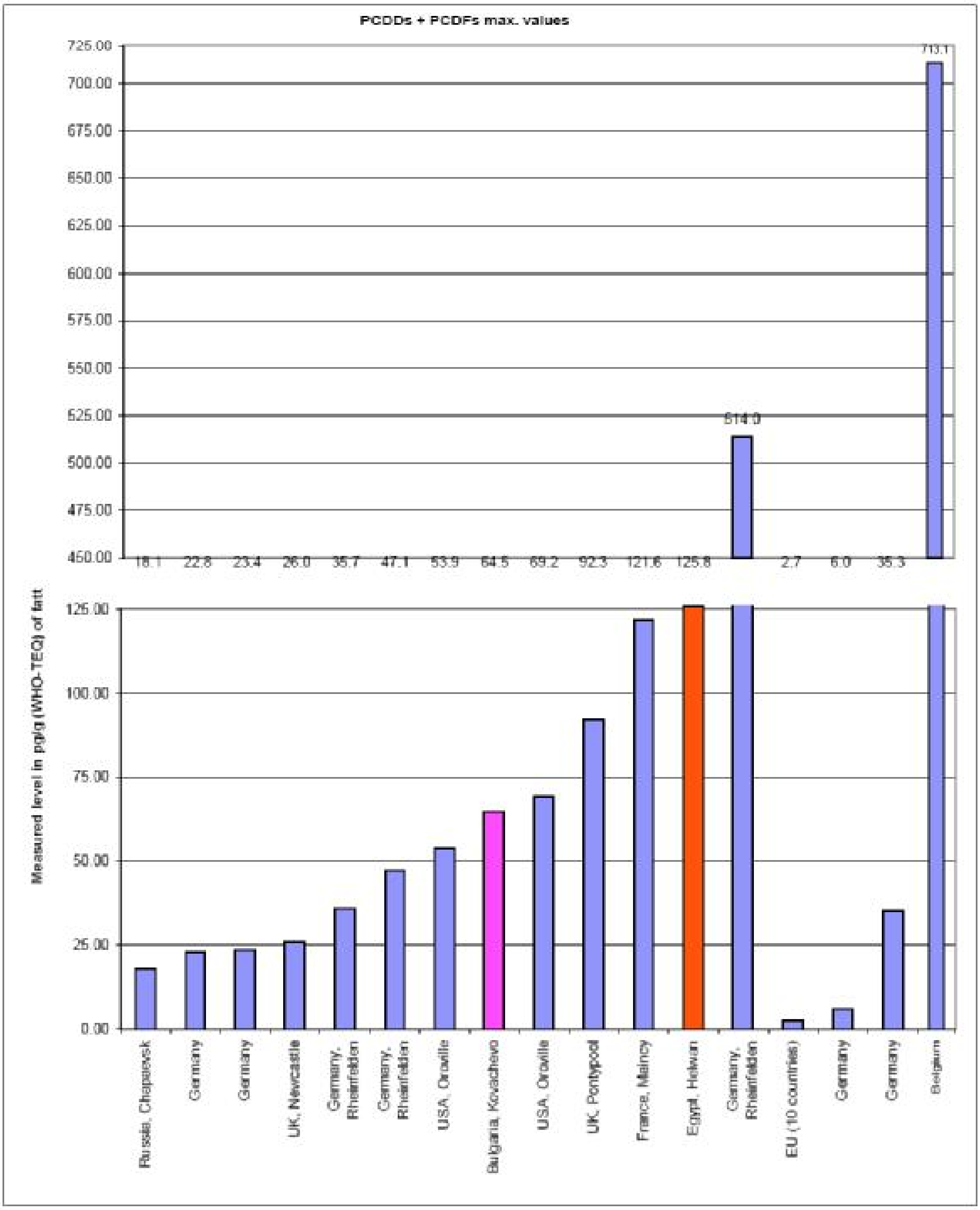
Country/locality	Year	Group	Number of eggs/measured samples	Measured level in pg/g (WHO-TEQ) of fat	Source of information
UK, Newcastle (background level)	2000	free range	3/1 pool	0.20	Pless-Mulloli, T. et al. 2001
Germany, Lower Saxony	1998	free range	60/6 pools	1.28	SCOOP Task 2000
UK, Newcastle (lowest level from pool samples)	2000	free range	3/1 pool	1.50	Pless-Mulloli, T. et al. 2001
Uruguay, Minas	2005	free range	8/1 pool	2.18	Axys Varilab 2005
Czech Republic, Liberec	2005	free range	3/1 pool	2.61	Axys Varilab 2005
Czech Republic, Usti nad Labem	2005	free range	6/1 pool	2.90	Axys Varilab 2005
Tanzania, Vikuge	2005	free range	6/1 pool	3.03	Axys Varilab 2005
Germany, Bavaria	1992	free range	370/37 pools	3.20	SCOOP Task 2000
Turkey, Izmit	2005	free range	6/1 pool	3.37	Axys Varilab 2005
Czech Republic, Klatovy	2003	free range	12	3.40	Beranek, M. et al. 2003
Belarus, Bolshoi Trostenec	2005	free range	6/1 pool	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 pool	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 pool	19.80	Axys Varilab 2005
Mexico, Coatzacoalcos	2005	free range	6/1 pool	21.63	Axys Varilab 2005
Kenya, Dandora	2004	free range	6/1 pool	22.92	Axys Varilab 2005
UK, Newcastle (highest level from pool samples)	2000	free range	3/1 pool	31.00	Pless-Mulloli, T. et al. 2001
Senegal, Mbeubeuss	2005	free range	6/1 pool	35.10	Axys Varilab 2005
Bulgaria, Kovachevo	2005	free range	6/1 pool	64.54	Axys Varilab 2005
Egypt, Helwan	2005	free range	6/1 pool	125.78	Axys Varilab 2005


PCDD/Fs pool samples
Measured level in pg/g (WHO-TEQ) of fat
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.2
1.3
1.5
2.2
2.6
2.9
3.0
3.2
3.4
3.4
3.9
6.8
10.6
11.5
14.9
19.8
21.6
22.9
31.0
35.1
64.5
125.8
UK, Newcastle (background level)
Germany, Lower Saxony
UK, Newcastle (lowest level from pool samples)
Uruguay, Minas
Czech Republic, Liberec
Czech Republic, Usti nad Labem
Tanzania, Vikuge
Germany, Bavaria
Turkey, Izmit
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
Mexico, Coatzacoalcos
Kenya, Dandora
UK, Newcastle (highest level from pool samples)
Senegal, Mbeubeuss
Bulgaria, Kovachevo
Egypt, Helwan

Annex 4: Maximum levels of dioxins (PCDD/Fs) in different groups of analyzed chicken eggs from different parts of world

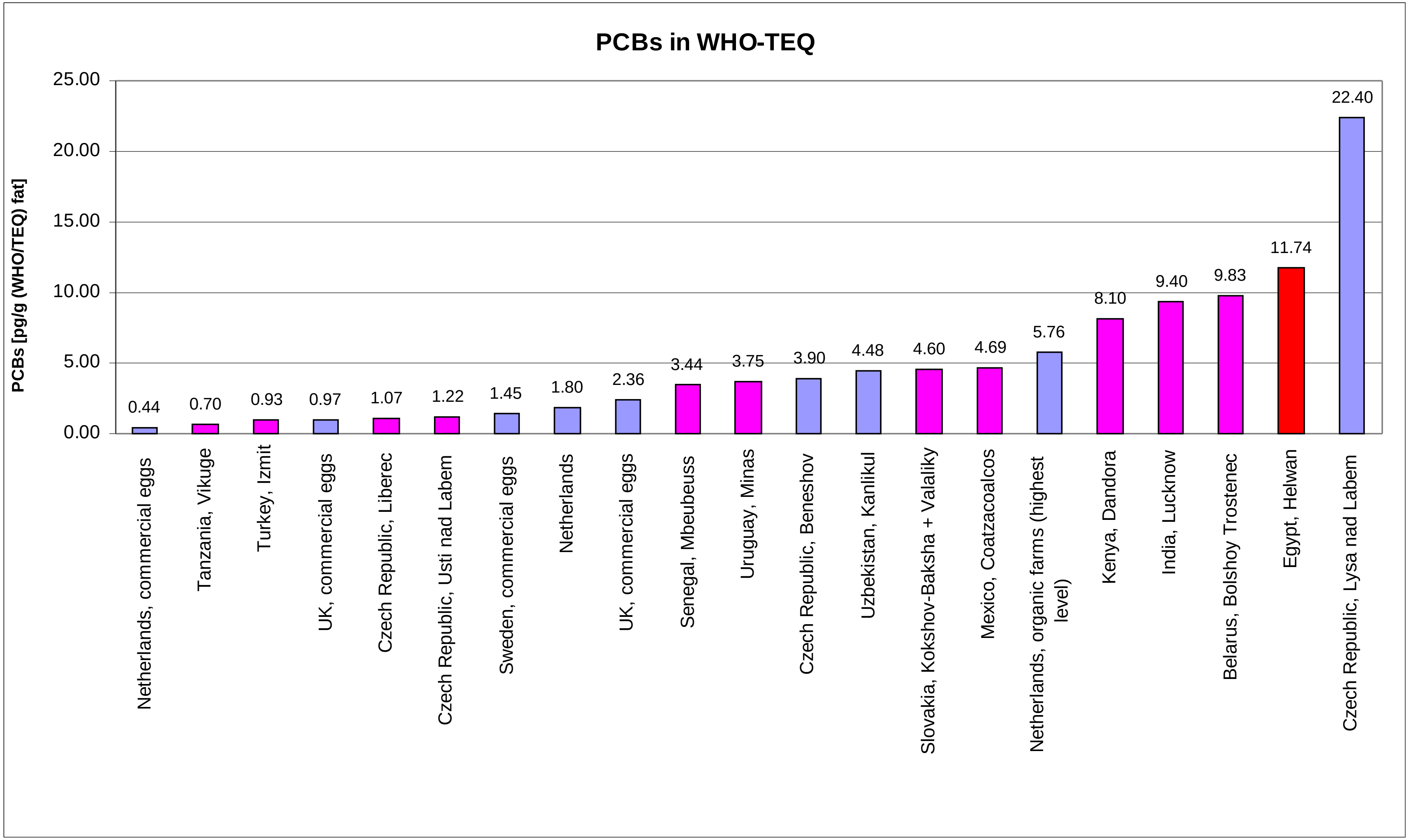
Country	Date/year	Group	Measured level in pg/g (WHO-TEQ) of fat	Source of information
Russia, Chapaevsk	1994	free range	18.10	Sotskov, U., P., Revich, B., A. et al. 2000
Germany	1995	free range	22.80	CLUA Freiburg 1995
Germany	1993	free range	23.40	Fuerst 1993
UK, Newcastle	2002	free range	26.00	Pless-Mulloli, T. et al. 2003b
Germany, Rheinfelden	1991	free range	35.70	Malisch, R. et al. 1996
Germany, Rheinfelden	1991	free range	47.10	Malisch, R. et al. 1996
USA, Oroville	1994	free range	53.85	Harnly, M. E. et al. 2000
Bulgaria, Kovachevo	2005	free range	64.54	Axys Varilab 2005
USA, Oroville	1988	free range	69.23	Harnly, M. E. et al. 2000
UK, Pontypool	1993 - 1994	free range	92.31	Lovett, A. A. et al. 1998 *]
France, Maincy	2004	free range	121.55	Pirard, C. et al. 2004
Egypt, Helwan	2005	free range	125.78	Axys Varilab 2005
Germany, Rheinfelden	1992	free range	514.00	Malisch, R. et al. 1996
EU (10 countries)	1990-99	not free range	2.67	Hansen, E., Hansen, C. L. 2003
Germany	1995	not free range	6.04	CLUA Freiburg 1995
Germany	1993 - 1996	not free range	35.29	Malisch, R. 1998
Belgium	1999	not free range	713.10	Larebeke, N. van et al. 2001

*] median level from 3 bantam chicken eggs samples measured close to hazardous waste incinerator


PCDDs + PCDFs max. values
Measured level in pg/g (WHO-TEQ) of fatt
725.00
700.00
675.00
650.00
625.00
600.00
575.00
550.00
525.00
500.00
475.00
450.00
125.00
100.00
75.00
50.00
25.00
0.00
713.1
514.0
18.1
22.8
23.4
26.0
35.7
47.1
53.9
64.5
69.2
92.3
121.6
125.8
2.7
6.0
35.3
Russia, Chapaevsk
Germany
Germany
UK, Newcastle
Germany, Rheinfelden
Germany, Rheinfelden
USA, Oroville
Bulgaria, Kovachevo
USA, Oroville
UK, Pontypool
France, Maincy
Egypt, Helwan
Germany, Rheinfelden
EU (10 countries)
Germany
Germany
Belgium

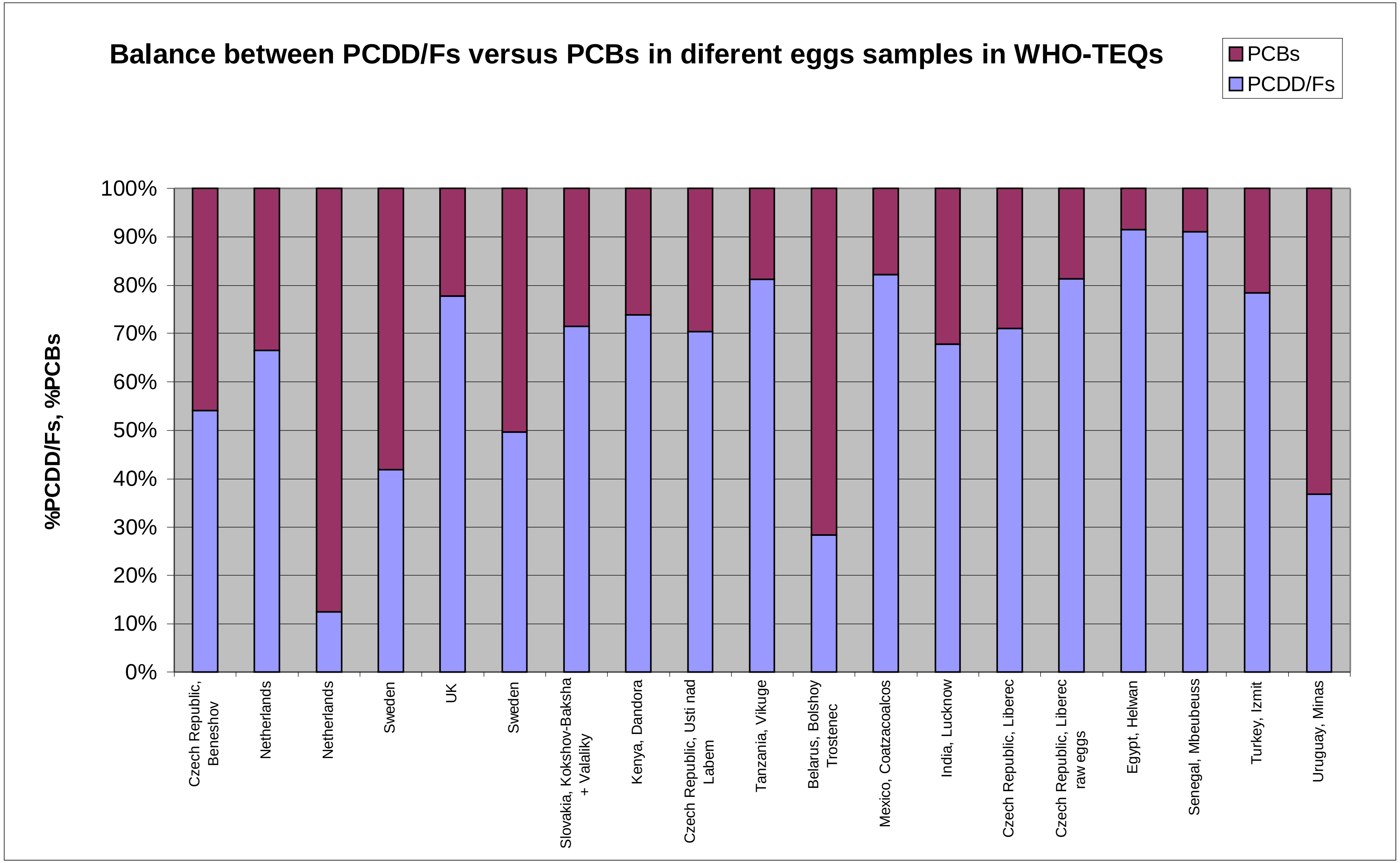
Annex 5: Levels of PCBs in WHO-TEQ in different chicken eggs samples from different parts of world

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
Tanzania, Vikuge	2005	free range	6/1 pool	pool	0.70	Axys Varilab 2005
Turkey, Izmit	2005	free range	6/1 pool	pool	0.93	Axys Varilab 2005
UK, commercial eggs	1992	not free range	24/1 pool	pool	0.97	SCOOP Task 2000
Czech Republic, Liberec	2005	free range	3/1 pool	pool	1.07	Axys Varilab 2005
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
Netherlands	1990	mixed	8/2 pools	pool, nonortho-PCBs	1.80	SCOOP Task 2000
UK, commercial eggs	1982	not free range	24/1 pool	pool	2.36	SCOOP Task 2000
Senegal, Mbeubeuss	2005	free range	6/1 pool	pool	3.44	Axys Varilab 2005
Uruguay, Minas	2005	free range	8/1 pool	pool	3.75	Axys Varilab 2005
Czech Republic, Beneshov	2004	free range	4	pool	3.90	Axys Varilab 2004
Uzbekistan, Kanlikul	2001	free range	-	individual	4.48	Muntean, N. et al. 2003
Slovakia, Kokshov-Baksha + Valaliky	2005	free range	6/1 pool	pool	4.60	Axys Varilab 2005
Mexico, Coatzacoalcos	2005	free range	6/1 pool	pool	4.69	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 pool	pool	9.40	Axys Varilab 2005
Belarus, Bolshoy Trostenec	2005	free range	6/1 pool	pool	9.83	Axys Varilab 2005
Egypt, Helwan	2005	free range	6/1 pool	pool	11.74	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]
25.00
20.00
15.00
10.00
5.00
0.00
0.44
0.70
0.93
0.97
1.07
1.22
1.45
1.80
2.36
3.44
3.75
3.90
4.48
4.60
4.69
5.76
8.10
9.40
9.83
11.74
22.40
Netherlands, commercial eggs
Tanzania, Vikuge
Turkey, Izmit
UK, commercial eggs
Czech Republic, Liberec
Czech Republic, Usti nad Labem
Sweden, commercial eggs
Netherlands
UK, commercial eggs
Senegal, Mbeubeuss
Uruguay, Minas
Czech Republic, Beneshov
Uzbekistan, Kanlikul
Slovakia, Kokshov-Baksha + Valaliky
Mexico, Coatzacoalcos
Netherlands, organic farms (highest level)
Kenya, Dandora
India, Lucknow
Belarus, Bolshoy Trostenec
Egypt, Helwan
Czech Republic, Lysa nad Labem

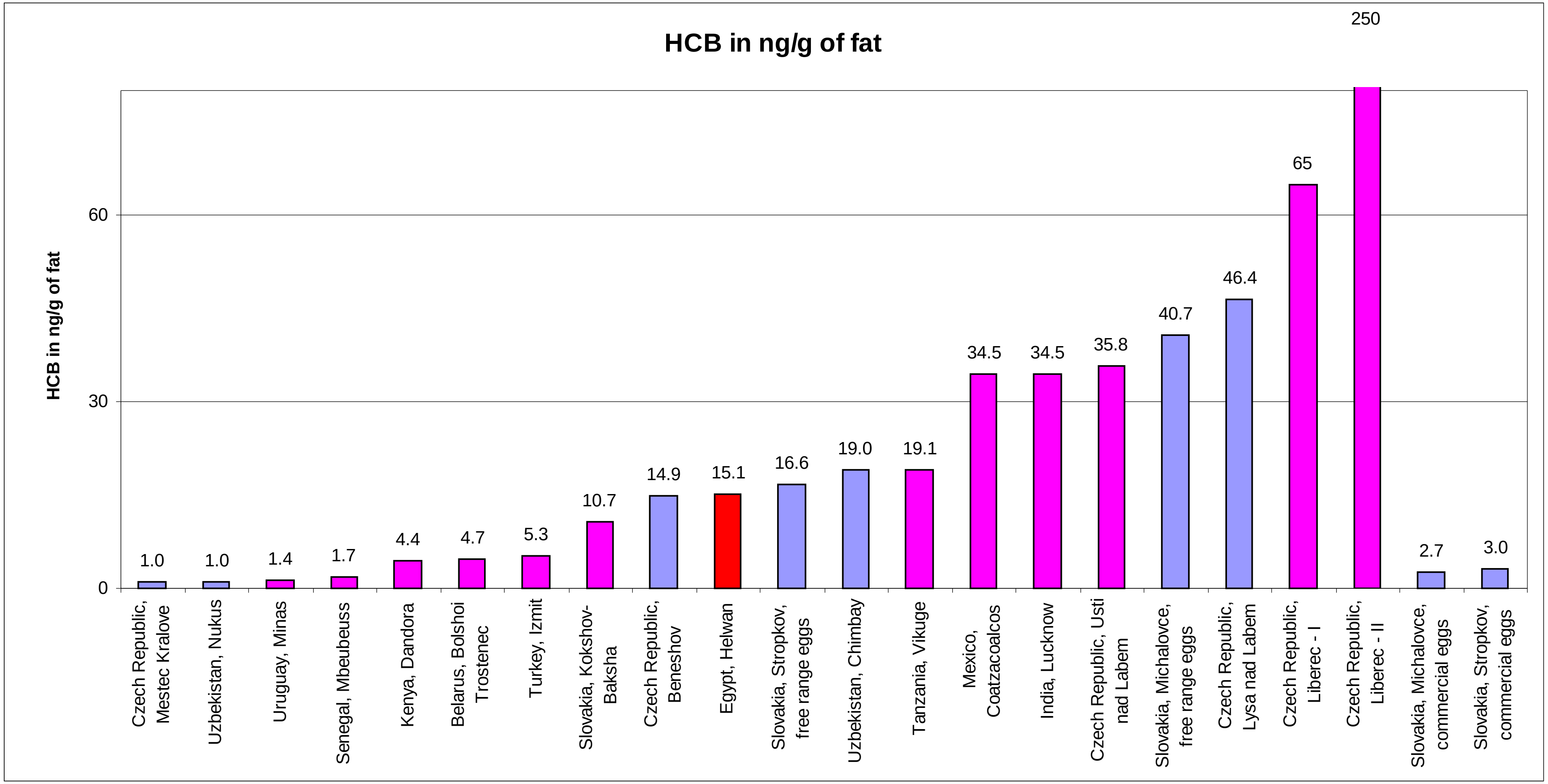
Annex 6: Balance between PCDD/Fs versus PCBs in diferent eggs samples in WHO-TEQs

Country/locality	Year	Group	PCDD/Fs	PCBs	Total WHO-TEQ	Source of information
Czech Republic, Beneshov	2004	free range	4.60	3.90	8.50	Axys Varilab 2004
Netherlands	2002	free range	3.01	1.52	4.53	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, Dandora	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
Tanzania, Vikuge	2005	free range	3.03	0.70	3.73	Axys Varilab 2005
Belarus, Bolshoy Trostenec	2005	free range	3.91	9.83	13.74	Axys Varilab 2005
Mexico, Coatzacoalcos	2005	free range	21.63	4.69	26.32	Axys Varilab 2005
India, Lucknow	2005	free range	19.80	9.40	29.20	Axys Varilab 2005
Czech Republic, Liberec	2005	free range	2.63	1.07	3.70	Axys Varilab 2005
Czech Republic, Liberec raw eggs	2005	free range	2.61	0.60	3.21	Axys Varilab 2005
Egypt, Helwan	2005	free range	125.78	11.74	137.52	Axys Varilab 2005
Senegal, Mbeubeuss	2005	free range	35.10	3.44	38.54	Axys Varilab 2005
Turkey, Izmit	2005	free range	3.37	0.93	4.30	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, Beneshov
Netherlands
Netherlands
Sweden
UK
Sweden
Slovakia, Kokshov-Baksha + Valaliky
Kenya, Dandora
Czech Republic, Usti nad Labem
Tanzania, Vikuge
Belarus, Bolshoy Trostenec
Mexico, Coatzacoalcos
India, Lucknow
Czech Republic, Liberec
Czech Republic, Liberec raw eggs
Egypt, Helwan
Senegal, Mbeubeuss
Turkey, Izmit
Uruguay, Minas

Annex 7: Levels of HCB in ng/g of fat in different chicken eggs samples from different parts of world

Country	Date/year	Group	Number of measured samples	Measured level in ng/g of fat	Source of information
Czech Republic, Mestec Kralove	2003	free range	3	1.0	SVA CR 2004
Uzbekistan, Nukus	2001	free range	-	1.0	Muntean, N. et al. 2003
Uruguay, Minas	2005	free range	8/1 pool	1.4	Axys Varilab 2005
Senegal, Mbeubeuss	2005	free range	6/1 pool	1.7	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
Turkey, Izmit	2005	free range	6/1 pool	5.3	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
Egypt, Helwan	2005	free range	6/1 pool	15.1	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
Tanzania, Vikuge	2005	free range	6/1 pool	19.1	Axys Varilab 2005
Mexico, Coatzacoalcos	2005	free range	6/1 pool	34.5	Axys Varilab 2005
India, Lucknow	2005	free range	4/1 pool	34.5	Axys Varilab 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
Czech Republic, Lysa nad Labem	2004	free range	1	46.4	Axys Varilab 2005
Czech Republic, Liberec - I	2005	free range	3/1 pool	65	Axys Varilab 2005
Czech Republic, Liberec - II	2005	free range	3/1 pool	250	Axys Varilab 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 fat
0
30
60
250
1.0
1.0
1.4
1.7
4.4
4.7
5.3
10.7
14.9
15.1
16.6
19.0
19.1
34.5
34.5
35.8
40.7
46.4
65
2.7
3.0
Czech Republic, Mestec Kralove
Uzbekistan, Nukus
Uruguay, Minas
Senegal, Mbeubeuss
Kenya, Dandora
Belarus, Bolshoi Trostenec
Turkey, Izmit
Slovakia, Kokshov-Baksha
Czech Republic, Beneshov
Egypt, Helwan
Slovakia, Stropkov, free range eggs
Uzbekistan, Chimbay
Tanzania, Vikuge
Mexico, Coatzacoalcos
India, Lucknow
Czech Republic, Usti nad Labem
Slovakia, Michalovce, free range eggs
Czech Republic, Lysa nad Labem
Czech Republic, Liberec - I
Czech Republic, Liberec - II
Slovakia, Michalovce, commercial eggs
Slovakia, Stropkov, commercial eggs

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