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Contamination of chicken eggs from the Dzerzhinsk region, Russia by dioxins, PCBs and hexachlorobenzene

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“Keep the Promise, Eliminate POPs!” Campaign Report

Prepared by Dioxin, PCBs and Waste Working Group of the International POPs Elimination Network (IPEN) Secretariat, Eco-SPES (Russia), Eco-Accord (Russia) and Arnika Association (Czech Republic)

Executive Summary

Free-range chicken eggs collected in Igumnovo and Gorbatovka, near the chlorine chemicals producing plants and hazardous waste incinerators in Dzerzhinsk, Russia showed contaminant levels exceeding the EU limit for dioxins as well as the newly proposed limit for PCBs. Eggs from Igumnovo had almost a 14-fold higher level of dioxins than the EU limit and 9 times the level of PCBs specified by the newly proposed EU limit for these substances. Eggs from Gorbatovka were less contaminated by these substances, but still had dioxin levels t4 times higher than EU limit and PCB levels 4.5 times higher than newly proposed limit for these chemicals in WHO-TEQ. To our knowledge, this study represents the second study of U-POPs in chicken eggs from Russia.

Taking into account all circumstances and the congener pattern of dioxins in the eggs, the most obvious source of U-POPs in eggs sampled from Igumnovo and Gorbatovka are local chlor-alkali and other chlorinated chemicals production industries and their waste dumpsites within the region. We can not exclude open burning of municipal waste as additional source of dioxins in eggs. HCB and PCBs might be contaminating chemicals used and/or produced in the past or generated unintentionally during some of chemical production within the studied area. The results of this study call for including dioxins, PCBs, and HCB into regular monitoring in Dzerzhinsk, which has already started measuring many other chemicals. Dzerzhinsk, is the world's most polluted industrial town according to the Guinness Book of World Records.

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. Russian Federation signed the Convention 22nd May 2002 and plans to ratify it. The Convention mandates Parties to take specific actions aimed at eliminating these pollutants from the global environment. We view the Convention text as a promise to take the actions needed to protect Russian 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 Russian Federation’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) A basic inventory of POPs content in wastes and an inventory of sites contaminated by POPs in Dzerzhinsk is needed followed by plans for clean up;

2) More publicly accessible data about U-POPs releases to all compartments of the environment from the chemical complexes are needed to address sources of U-POPs in Dzerzhinsk area properly. That data should be incorporated in the National POPs Inventory;

3) Actions for the continuing minimization and where feasible elimination of U-POPs releases at the chemical complexes should be incorporated in the National Implementation Plan of the Stockholm

Convention. The incineration of chlorinated waste may increase U-POPs generation. As general policy is recommended the substitution of materials and products that avoid the use of PVC;

4) Raise public awareness and understanding of U-POPs impact on human health to avoid additional releases of U-POPs from solid waste burning including PVC

5) A health impact study of the population exposed to U-POPs in Dzerzhinsk is needed and also actions to prevent future exposure. The region should be evaluated as a potential hot spot in the National Implementation Plan of the Stockholm Convention;

6) The lack of data about levels of U-POPs in food sources in Russia supports the need to establish a regular monitoring system for these chemicals in food;

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

8) Include PCBs and HCB in the UNEP Toolkit and set strict limits for these chemicals in wastes in all other documents prepared under the Stockholm Convention.

Introduction

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

The international community has responded to the POPs threat by adopting the Stockholm Convention in May 2001. The Convention entered into force in May 2004 and the first Conference of the Parties (COP1) will take place on 2 May 2005 in Uruguay. Russian Federation signed the Convention 22nd May 2002 and plans to ratify it.

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 chlorine chemical plants and hazardous waste incinerator in Dzerzhinsk, Russia were selected as a sampling site since both chlorine industry and hazardous waste incineration 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 U-POPs in eggs in the Dzerzhinsk area.

Materials and Methods

Please see Annex 1.

Results and Discussion

U-POPs in eggs sampled near Dzerzhinsk in Russia

The results of the analysis of two pooled samples of 4 eggs collected in Gorbatovka and Igumnovo near chlorine chemical plants and hazardous waste incinerators in Dzerzhinsk are summarized in Tables 1 and 2. The fat content of the pooled samples was measured in eggs from Igumnovo and Gorbatovka at 10.9% and 12.9% respectively.

The sampled eggs from both localities exceeded the EU limit for dioxins as well as newly proposed limit for PCBs. Eggs from Igumnovo had almost a 14-fold higher level of dioxins than the EU limit and 9 times higher level of PCBs than newly proposed limit for these substances in WHO-TEQ. Eggs from Gorbatovka were less contaminated by U-POPs, but still had dioxin levels 4 times higher than the EU limit and PCB levels 4.5-times higher than newly proposed limit for these chemicals in WHO-TEQ.

Table 1: Measured levels of POPs in eggs collected in two sites near Dzerzhinsk per gram of fat.

	Russia – Igumnovo	Russia – Gorbatovka	Limits	Action level
PCDD/Fs in WHO-TEQ (pg/g)	44.69	12.68	3.0[a]	2.0 [b]
PCBs in WHO-TEQ (pg/g)	18.37	9.08	2.0[b]	1.5 [b]
Total WHO-TEQ (pg/g)	63.06	21.76	5.0[b]	-
PCB (7 congeners) (ng/g)	167.31	63.50	200[c]	-
HCB (ng/g)	11.80	68.90	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 that the level of dioxins in eggs in both villagtes expressed as fresh weight exceeded the limit for commercial eggs in the USA. The US Food and Drug Administration estimates a lifetime excess cancer risk of one in 10,000 for eggs contaminated at 1 pg/g ITEQ. The samples collected near Dzerzhinsk exceeded this cancer risk level.[a] In Igumnovo it was 4 times higher and in Gorbatovka it was by more than 0.6 pg WHO-TEQ/g fresh weight.

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

Table 2: Measured levels of POPs in eggs collected in two sites near Dzerzhinsk per gram of egg fresh weight.

	Russia – Igumnovo	Russia – Gorbatovka	Limits	Action level
PCDD/Fs in WHO-TEQ (pg/g)	4.87	1.64	1[a]	-
PCBs in WHO-TEQ (pg/g)	2.00	1.17	-	-
Total WHO-TEQ (pg/g)	6.87	2.81	-	-
PCBs (7 congeners) (ng/g)	18.24	8.19		
HCB (ng/g)	1.29	8.89	-	-

[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 second study of dioxins in chicken eggs ever reported in Russia. 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. Finally, more data about U-POPs releases from chemical processes where chlorine is present is needed in countries with economies under transition.

It is clear that among the U-POPs listed under the Stockholm Convention, dioxins are the main contaminants found in the eggs from Igumnovo and Gorbatovka. However, high levels of PCBs were also found in both samples high HCB levels were observed in the eggs from Gorbatovka. This finding supports the need for additional data on releases of these chemicals as U-POPs.

Comparison of the two samples from the Dzerzhinsk area

The dioxin levels in eggs from Igumnovo were 3.5 times higher than in the eggs from Gorbatovka. A comparable difference is seen in level of the seven PCB congeners. The levels of non-ortho and mono-ortho PCBs (in WHO-TEQ) differ a bit less compared to levels of dioxins and the seven PCB congeners. The situtation with HCB level is the opposite: The eggs from Gorbatovka showed HCB levels six-times higher the eggs from Gorbatovka.

The influence of soil pollution levels on dioxin content in chicken eggs has been discussed in several studies. The most detailed discussion is probably the second study from Catherine Pirard's team about dioxins and PCBs in soils and eggs from the surroundings of an old waste incinerator in France. [2]

We have collected eggs from 3 different chicken fanciers in Gorbatovka and 2 in Igumnovo, so we believe that the results presented in this study provide a broader picture of the levels of toxic chemicals in chicken eggs (as a biomonitoring tool for evaluation of environmental contamination) compared to collecting eggs from one family at one place within the village.

In general the levels of U-POPs found in Igumnovo and Gorbatovka are relatively high comparing to data from other studies as we show in following chapter.

Comparison with other studies of eggs

We compared the levels of PCDD/Fs measured in this study in eggs from Igumnovo and Gorbatovka in Russia 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,[3] Kenya,[4] Czech Republic,[5] Belarus,[6] India (Uttar Pradesh),[7] Tanzania,[8] Senegal,[9] Mexico,[10] Turkey,[11] Bulgaria,[12] Uruguay,[13] Egypt[14] and India (Kerala)[15] released since 21 March 2005.

The dioxin levels in eggs in this study exceeded background levels by 37-fold (Igumnovo) and 10-fold (Gorbatovka) respectively (background levels = 0.2 - 1.2 pg WHO-TEQ/g of fat). Dioxins in eggs from Igumnovo show higher dioxin levels than the average concentration in eggs from Maincy in France (surrounding of an old shut down waste incinerator), and were approximately one-third of the maximum level measured in eggs from Maincy. [16]

Dioxins in eggs from Gorbatovka were comparable to those collected near the Koshice municipal waste incinerator in Slovakia[17] and higher than recently measured in free range chicken eggs from the Antwerp province in Belgium.[18]

A comparison of the Igumnovo eggs measured here with other highly contaminated eggs shows that these eggs belong to those with higher doses of dioxins (see Annex 4). The levels of dioxins in eggs from Igumnovo are very close to the levels found in the area of a former disposal site connected to chlor-alkali and pentachlorophenol production in Rheinfelden, Germany.[19] The eggs examined here showed lower levels than eggs from Oroville, USA at place influenced by wood treatment with pentachlorophenol, where some fires also occurred.[20]

PCBs levels expressed in WHO-TEQs in eggs collected in Gorbatovka are comparable to those found in free range eggs from the neighborhood of the Dandora dumpsite in Kenya,[21] near a medical waste incinerator in Lucknow, India[22] and/or from the neighborhood of another dumpsite in Bolshoi Trostenec, Belarus.[23] These levels are almost less than half of the level of PCBs (in WHO-TEQ) found in a pooled sample of 4 eggs collected near a hazardous waste incinerator in Lysa nad Labem in the Czech Republic[24]. In contrast, the eggs from Igumnovo showed PCB levels much closer to those observed in eggs near the Czech incinerator. If we compare these levels with the maximum levels of PCBs (in WHO-TEQs) then higher levels than these were found for example in free range eggs from places where cow carcasses were burned after foot and mouth disease in Anglesey, UK (82.0 pg WHO-TEQ/g of fat),[25] in Maincy, France (52.5 pg WHO-TEQ/g of fat) [26] and/or in egg sampled near chemical plant Spolana in the Czech Republic (42.9 pg WHO-TEQ/g of fat).[27] The highest value of PCBs in WHO-TEQ was measured in eggs during the Belgian dioxin scandal in 1999 (396.1 pg WHO-TEQ/g of fat). [28]

Levels for the 7 PCB congeners were very high in eggs from Igumnovo and elevated in eggs from Gorbatovka. Igumnovo eggs had comparable loads of 7 PCB congeners with eggs collected in Kokshov-Baksha and Valaliky, Slovakia (189.0 ng/g of fat),[29] but were lower than maximum value shown in eggs from free range chickens raised on organic farms in Ireland (275.9 ng/g of fat).[30]

HCB levels in eggs from Gorbatovka are among the highest levels found within the eggs collected during the IPEN global project and are comparable to some levels measured in the Czech Republic (see Annex 6). They are two times higher than HCB levels observed in from Coatzacoalcos, Mexico.[31] HCB levels in eggs from Igumnovo are also elevated since they almost 12-fold higher than background levels.

PCBs contribute less than 30% (Igumnovo) and a bit more than 40% (Gorbatovka) of the whole WHO-TEQ value in these eggs as visible from the graph in Annex 5.

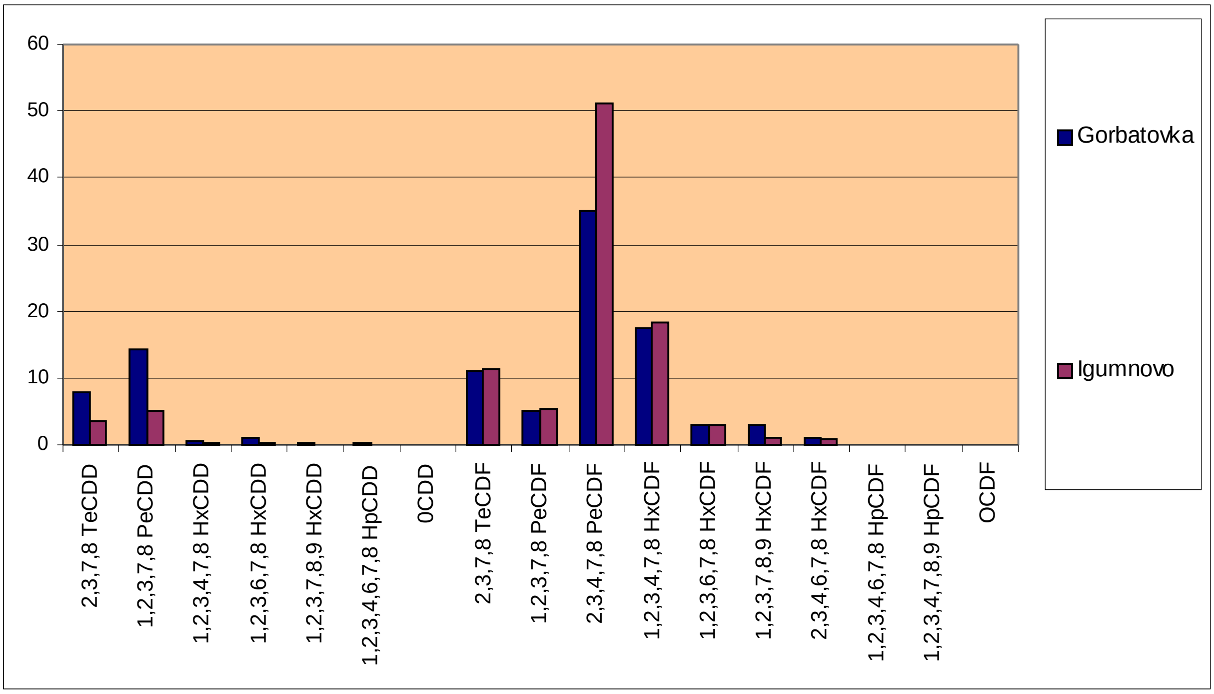
Possible U-POPs sources

The high levels of all U-POPs listed under Annex C of the Stockholm Convention observed in this study provoke the question of possible sources. There are several potential pollution sources within the Dzerzhinsk near the sampling sites. All of them are chlorine chemical industry plants and related activities (see following chapters with potential sources listed). Potential sources can be chlor-alkali plants, chlorine chemicals production plants (former production of PCBs, pesticides, chemical weapons and/or current production of PVC etc.), hazardous waste incinerators burning waste within these plants and finally hazardous waste landfills. Also open burning of municipal waste at the regional landfill located near Gorbatovka and local heating in the sites can be additional sources of U-POPs.

Tracking the source of dioxins in eggs can be aided by comparing the pattern of congeners in the samples with those in the sources. Seventeen PCDD/Fs congeners patterns in eggs from Gorbatovka and Igumnovo are shown in the graph in Picture 1 and measured levels are shown in Table 3.

The congener pattern shown by both pooled samples reflects the typical patterns for chlor alkali processes with graphite electrodes[32] (2,3,4,7,8 PeCDF, HxDCFs, 2,3,7,8 TeCDF and 1,2,3,7,8 PeCDF - expressed in WHO-TEQ). Please see this pattern demonstrated in Picture 2. However the dioxin pattern in eggs from the Dzerzhinsk region is not completely the same as found in other chlor alkali processes, as there is larger value of 2,3,7,8 TeCDD and 1,2,3,7,8 PeCDD compared to other congener patterns for chlor alkali processes. We suspect that the higher doses of these congeners could have their origin in the other potential POPs sources within the area. Compared to patterns observed in other eggs during IPEN global monitoring project, the eggs sampled in Dzerzhinsk region specifically show a high value for the 1,2,3,4,7,8 HxCDF congener which is typical for chlor alkali processes.

Picture 1: Graph showing a PCDD/Fs patterns in eggs from Gorbatovka and Igumnovo expressed in WHO-TEQs (% of congeners from whole PCDD/Fs WHO-TEQ).



Picture 2: Graph showing a PCDD/Fs pattern for chlor alkali process, old type with graphite electrode, expressed in WHO-TEQs (% of congeners from whole PCDD/Fs WHO-TEQ). Source of basic data: Rappe, C. et al. 1991.[33] This pattern was found in sludges from chlor alkali processes.

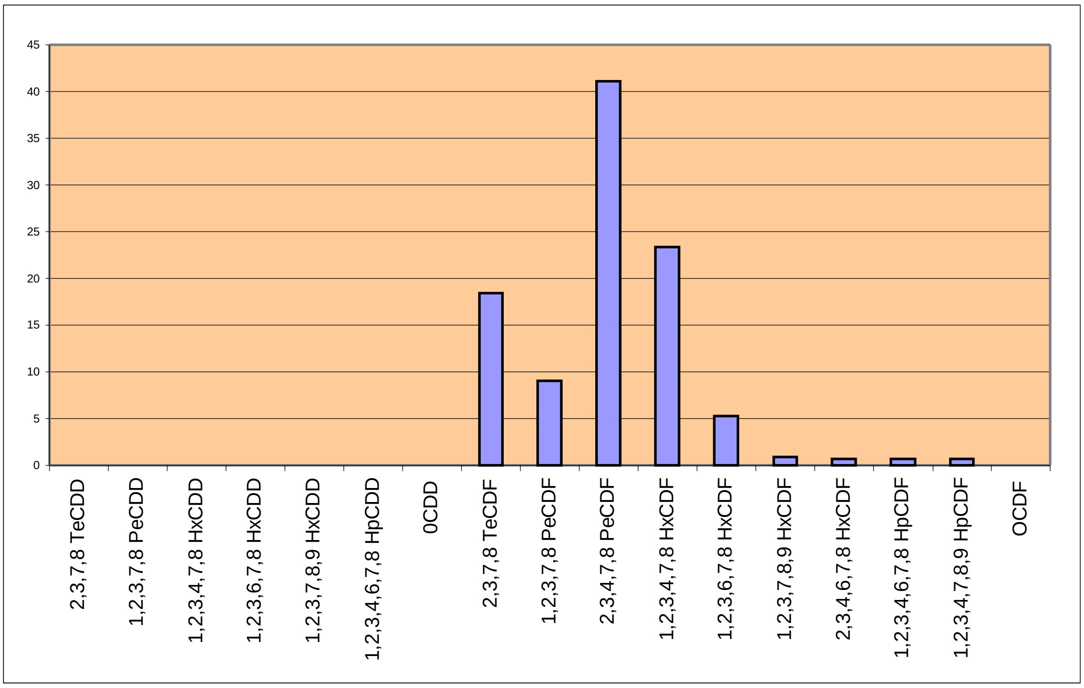


Table 3: Results of PCDD/Fs analysis in two pooled samples of 4 eggs collected in Dzerzhinsk region, Russia.[34]

PCDD/Fs congeners	WHO-TEF	**Gorbatovka**		**Igumnovo**	
		Values in pg/g of fat	Values in WHO-TEQ	Values in pg/g of fat	Values in WHO-TEQ
2,3,7,8 TeCDD	1	1.00	1	1.60	1.6
1,2,3,7,8 PeCDD	1	1.80	1.8	2.30	2.3
1,2,3,4,7,8 HxCDD	0.1	0.73	0.073	0.95	0.095
1,2,3,6,7,8 HxCDD	0.1	1.30	0.13	1.30	0.13
1,2,3,7,8,9 HxCDD	0.1	0.49	0.049	0.36	0.036
1,2,3,4,6,7,8 HpCDD	0.01	2.10	0.021	2.50	0.025
OCDD	0.0001	12.40	0.00124	11.60	0.00116
2,3,7,8 TeCDF	0.1	14.10	1.41	50.10	5.01
1,2,3,7,8 PeCDF	0.05	13.30	0.665	47.30	2.365
2,3,4,7,8 PeCDF	0.5	8.90	4.45	45.60	22.8
1,2,3,4,7,8 HxCDF	0.1	22.10	2.21	81.60	8.16
1,2,3,6,7,8 HxCDF	0.1	3.60	0.36	12.70	1.27
2,3,4,6,7,8 HxCDF	0.1	3.60	0.36	4.90	0.49
1,2,3,7,8,9 HxCDF	0.1	1.20	0.12	3.10	0.31
1,2,3,4,6,7,8 HpCDF	0.01	1.60	0.016	4.30	0.043
1,2,3,4,7,8,9 HpCDF	0.01	1.40	0.014	5.00	0.05
OCDF	0.0001	1.40	0.00014	3.40	0.00034

Prevail winds are south, south-west and west. The calm incidence is between one fifth to one fourth of cases during the year. Meteorological circumstances in the area in general support the hypothesis that chlorine chemical industry and its waste dumpsites can be considered as pollution sources for Gorbatovka and Igumnovo.

Taking into account all circumstances and dioxins congeners pattern in eggs, the most obvious source of U-POPs in eggs from Igumnovo and Gorbatovka are local chlor alkali and other chlorinated chemicals production industries and their wastes dumpsites within the region as they are described bellow. We also can not exclude open burning of municipal waste as an additional source of dioxins in the eggs.

HCB and PCBs might be contaminating chemicals used and/or produced in the past or generated unintentionally during some of chemical production within the studied area.

Dzerzhinsk - the most chemically polluted town in the world

Dzerzhinsk (population 300,000) has hosted many chemical factories, including production facilities for Sarin and VX nerve gas. Lead additives for gasoline, mustard gas, munitions, and other highly-polluting products have also had their birth in this city. While many of these factories are now shuttered, the chemical industry still employs over a quarter of the local residents.

The groundwater and soil around the city, about 250 miles east of Moscow, remain severely polluted with phenol, arsenic, dioxins, heavy metals, and many other toxic chemicals. Indeed, a dominant ecological landmark in the area is the “White Sea”, a 100-acre-wide lake of toxic sludge discharged from nearby factories.

According to the Guinness Book of World Records, Dzerzhinsk, is the world's most polluted industrial town. The city's annual death rate, 17 per 1,000 people, is much higher than Russia's national average of 14 per 1,000. According to researchers at the Nizhniy Novgorod Research Institute of Hygiene and Occupational Pathology, rates of reproductive health disturbances affecting women and fetuses, as well as rates of respiratory and pulmonary diseases in children, are dangerously high. [35]

The Director of the Regional Ecological Monitoring Centre, Sergei Ditatiev, admitted to BBC the following figures: Over 1,150 sources of pollution have been discovered. Of these more than 150 are of the most dangerous type.[36]

The reproductive health of the women living in Dzerzhinsk is threatened by environmental pollution. The outdoor air of the city is polluted with about 150 various chemical substances with almost 40 of them potential carcinogens and mutagens, and over 50 with embryotropic effects. It was shown that the rate of changes in immune status and some biochemical changes was higher in pregnant women living in the "polluted area" of the city, than in pregnant women of the "clean area". So immunological and biochemical tests can be suggested as early indicators of reproductive disorders due to environmental pollution.[37]

Nowadays investigations are also carried out to evaluate the carcinogenic risk to the population due to the actual atmospheric loads of chemical substances. The main chemical substances that determine the carcinogenic risk level were identified. They are benzo-a-pyrene, benzene, formaldehyde, dichloroethane, chlorobenzene, vinyl chloride, and nitrosamines. Results of some POPs levels measured in the environment are discussed in chapters specifically focused on Gorbatovka and Igumnovo. The share of carcinogenic substances in the actual atmospheric load varies from 50 to 75%. The high carcinogenic risk for the city residents was confirmed.[38] As shown in this study there are additionally U-POPs present in high concentrations in the region. Some of them are known to be carcinogenic and/or potentially carcinogenic to human.[39]

Gorbatovka and potential POPs sources

Gorbatovka is located at the distance of 2.5 km from the Eastern Industrial Zone of Dzerzhinsk, in-between Dzerzhinsk and Nizhniy Novgorod (at a distance of approximately 17 km from Dzerjinsk). The township population reaches about 4000 residents.

About 4 km to the north-east of the township, the liquid waste incineration facility of "Orgsteklo" Co. is located. In the former USSR, "Orgsteklo" Co. was a major producer of PCBs ("Sovol" and "Sovtol" brands) and PCT. Within the period from 1939 to 1990, 145 tons of these chemicals were produced there.

There are several places in the near surroundings of Gorbatovka with hazardous waste landfills, where both solid and liquid hazardous wastes were dumped. Some of them are still in use. In the settling pond called by local residents the Black Hole phenols containing effluents are disposed off. Phenol levels in the pond reach 430 mg/l, while phenol levels in the well at some distance from the pond reach 17,200.000 and 238.000 mg/l. The deep burial site for industrial wastewater of simazine herbicide production dumps over 2 million m^3 of industrial wastewater. The another landfill contains: salts of heavy metals, electroplating waste, and plastic waste. Now, the landfill is covered by a clay layer.

The municipal waste landfill located 1.5 - 2 km north west from Gorbatovka accumulates solid waste from Dzerzhinsk and Nizhniy Novgorod with the population of 1.5 million people. It has been operating since 1993. Cases of ignition of municipal waste are observed every week according to local inhabitants.

POPs measurements in the Gorbatovka area

In 1992, in outdoor air, nearby "Orgsteklo" Co., the following concentrations were registered: 2,3,7,8-TCDD (0.02 pg/m^3), 2,3,7,8-TCDF (1.30 pg/m^3). The concentration of 2,3,7,8-TCDD in snow at the distance of 300 m southwards from the incinerator reached 12 pg/m^2, levels of 2,3,7,8-TCDD and 1,2,3,7,8-PCDF reached 18 pg/m^2 and 45 pg/m^2, respectively. All measurements of PCDD/Fs are expressed in I-TEQ. In 1997, in soil, 9.0 ng/g of sum of PCBs was measured.

Igumnovo and potential POPs sources

The site is located southwards of major chemical production facilities with associated sludge settlers, pits, waste dumps and wastewater channels, along the groundwater flow from the north (from the industrial zone) to the south - towards the Oka river. The village population reaches about 600 residents.

At a distance of 3 km to the north-west from the village, «Kaprolaktam» a chlor alkali plant is located. The plant has been operating since 1939, it was the oldest facility of its type in the former USSR. It includes also an industrial waste incinerator. Besides that, a PVC production facility is also located there. The later one has been operating since 1970 (the oldest production line in the former USSR had become operational there in 1944). According to monitoring data of the Hydrometeorological Committee of the USSR, excessive levels of vinyl chloride were identified even at longer distances from the source. In some settlements vinyl chloride levels exceeded maximum acceptable levels by 20- to 40-fold.

At approximate distance of 4 km to the North-west from the village, "Korund" Company plant is located. From 1948 to 1980, the plant produced HCH. DDT was produced at the plant for several decades.

POPs and other chemicals measurements in the Igumnovo area

In 1999, the following substances were identified in soils: DDT (0.31, 0.25 mg/kg), gama-HCH (lindane) in concentrations below LOD, PCBs (0.10, 0.81 mg/kg). In soils of the Eastern Industrial Zone, the following concentrations of PCBs were found: 4.25 mg/kg, 3.23 mg/kg (in close proximity to chemical production facilities) and 1.71 mg/kg in a soil sample near the shop in the village of Igumnovo. In autumn 2002, in the soil sample taken near a residential house in Igumnovo, the DDT concentration was 0.6 mg/kg.

In monitoring wells in Igumnovo village, high levels of oil derivatives, phenols, formaldehyde, cyanides, benzene and acetone were found.

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. Russia signed the Convention in May 2002 and intends to ratify it.

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

The Stockholm Convention on POPs is historic. It is the first global, legally binding instrument whose aim is to protect human health and the environment by controlling production, use and disposal of toxic chemicals. We view the Convention text as a promise to take the actions needed to protect Russian 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 governmental representatives of Russian Federation and all stakeholders to honor the integrity of the Convention text and keep the promise of reduction and elimination of POPs.

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

Annex 1. Materials and Methods

Sampling

For sampling in Russia we have chosen two sites from the surroundings of the city Dzerzhinsk which contains a large number of long-operating chlorine chemical industries .

The eggs were collected from the village Igumnovo (south of Dzerzhinsk) and the little town of Gorbatovka (east of Dzerzhinsk on way to Nizhniy Novgorod). The hens from which the eggs were picked were all free-range.

In Igumnovo we collected 10 eggs from two chicken fanciers. The eggs were sampled from hens of ages between 3 - 6 years. Although they were regularly provided with grain once at day, the rest of their feeding is what they get from the soil. The range covered by the chickens was 60 - 80 square meters.

The site is located southwards of major chemical production facilities with associated sludge settlers, pits, waste dumps and wastewater channels, along the groundwater flow from the north (from the industrial zone) to the south - towards the Oka river.

In Gorbatovka we have sampled eggs from hens of age between 10 months and 6 years. Although regularly provided with grain and the leftovers from kitchen (not regularly), the rest of their feeding is what they get from the soil. The range covered by the chickens was 50 - 120 square meters. We collected 10 eggs from 3 chicken fanciers in Gorbatovka.

Sampling in Igumnovo was done by members of Eco-SPES on 11 January 2005 and in Gorbatovka on 10 January 2005. The eggs were kept in cool conditions after sampling and then transported at ambient temperature to Moscow, where they were boiled by members of Eco Accord for 7 - 10 minutes in pure water and transported by express services 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 from each locality 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

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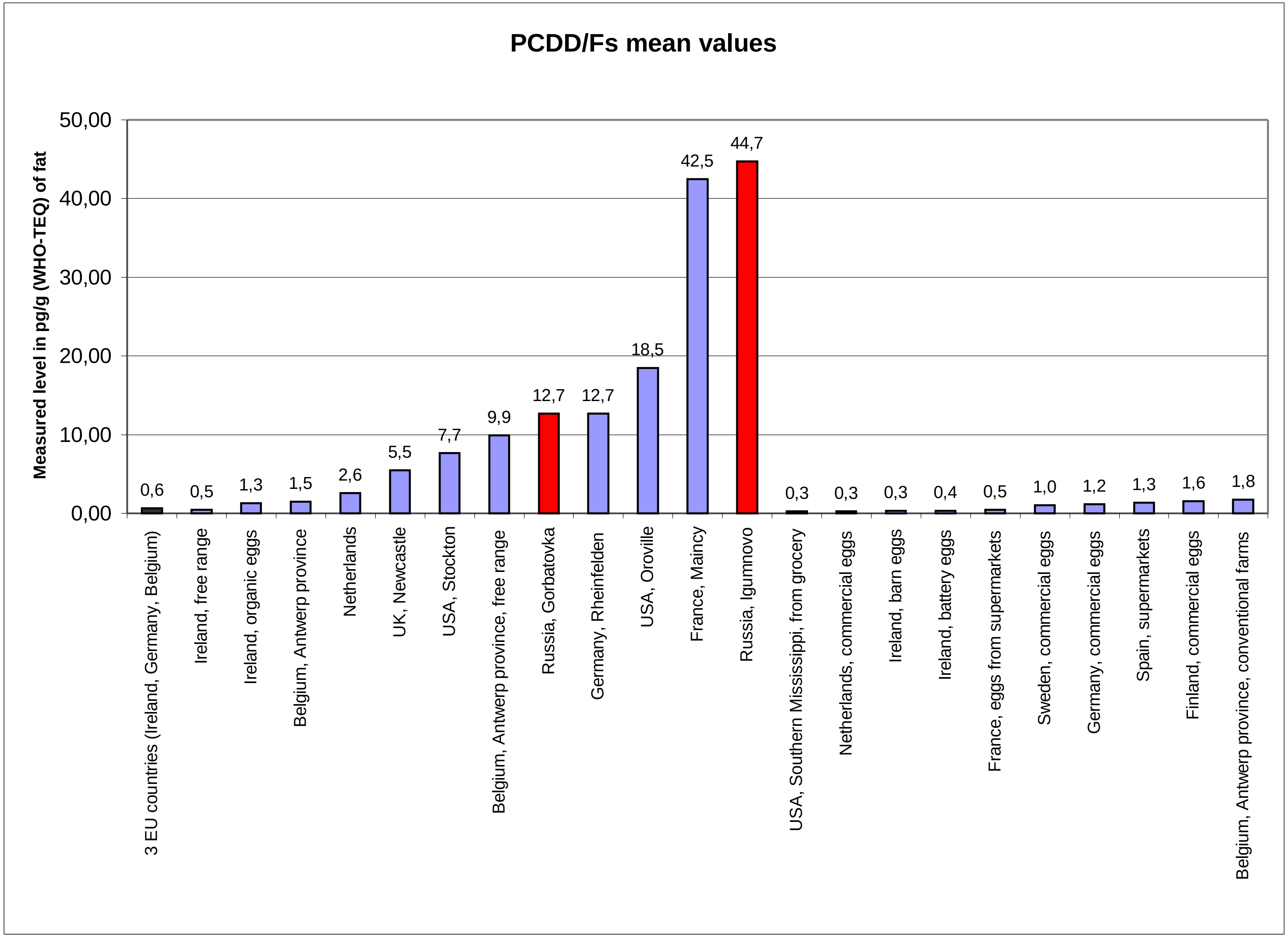
Annex 2: Mean values found within different groups of eggs from different parts of world

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
Russia, Gorbatovka	2005	free range	12,68	Axys Varilab 2005
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
Russia, Igumnovo	2005	free range	44,69	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
50,00
40,00
30,00
20,00
10,00
0,00
0,6
0,5
1,3
1,5
2,6
5,5
7,7
9,9
12,7
12,7
18,5
42,5
44,7
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
Russia, Gorbatovka
Germany, Rheinfelden
USA, Oroville
France, Maincy
Russia, Igumnovo
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

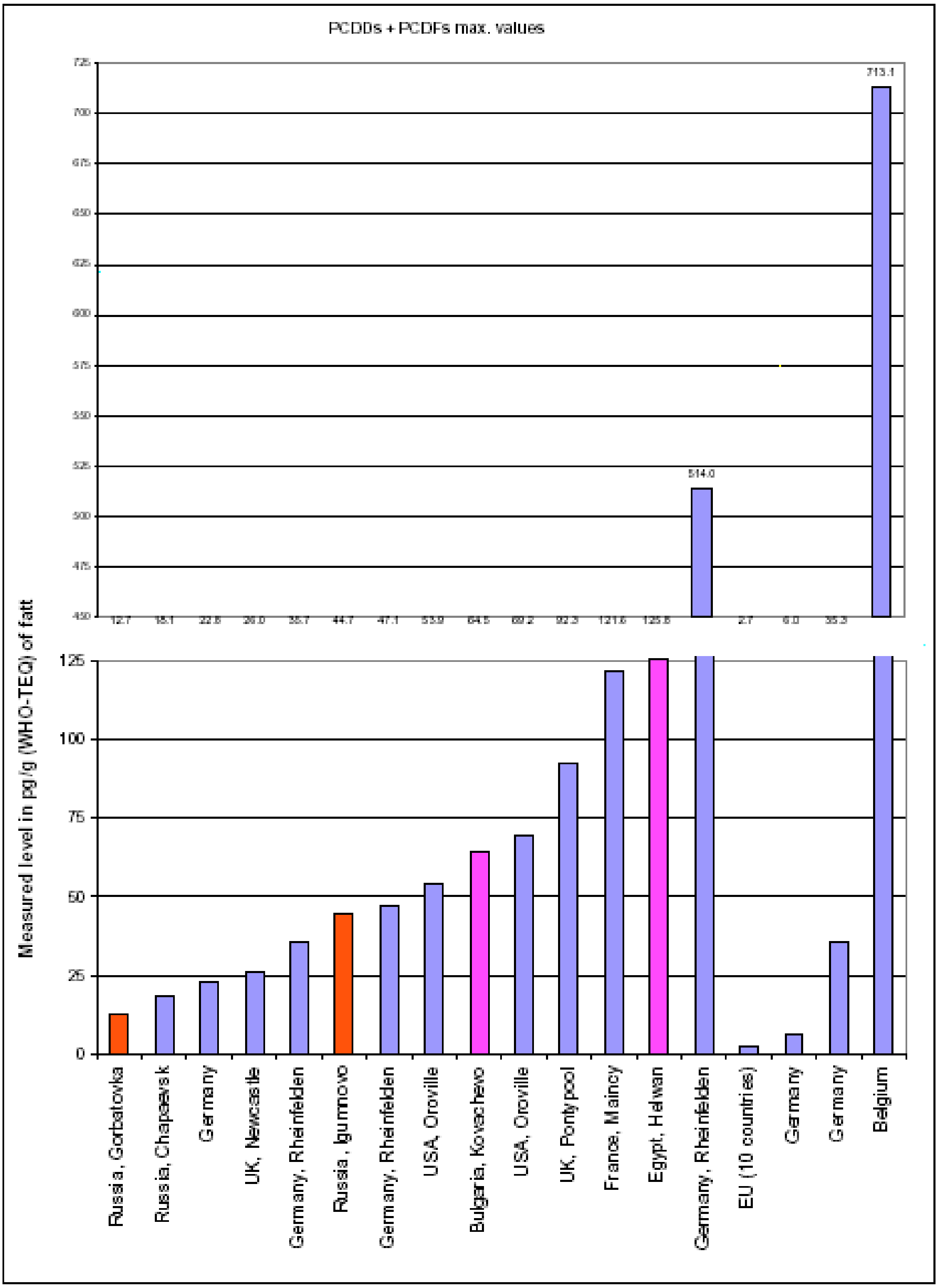
Annex 3: Levels of dioxins (PCDD/Fs) in different pool samples from different parts of world

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
Uruguay, Minas	2005	free range	8/1 pool	2,18	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
Belarus, Bolshoi Trostenec	2005	free range	6/1 pool	3,91	Axys Varilab 2005
Mozambique, Santos	2005	free range	6/1 pool	5,08	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
Russia, Gorbatovka	2005	free range	4/1 pool	12,68	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
Russia, Igumnovo	2005	free range	4/1 pool	44,69	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

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

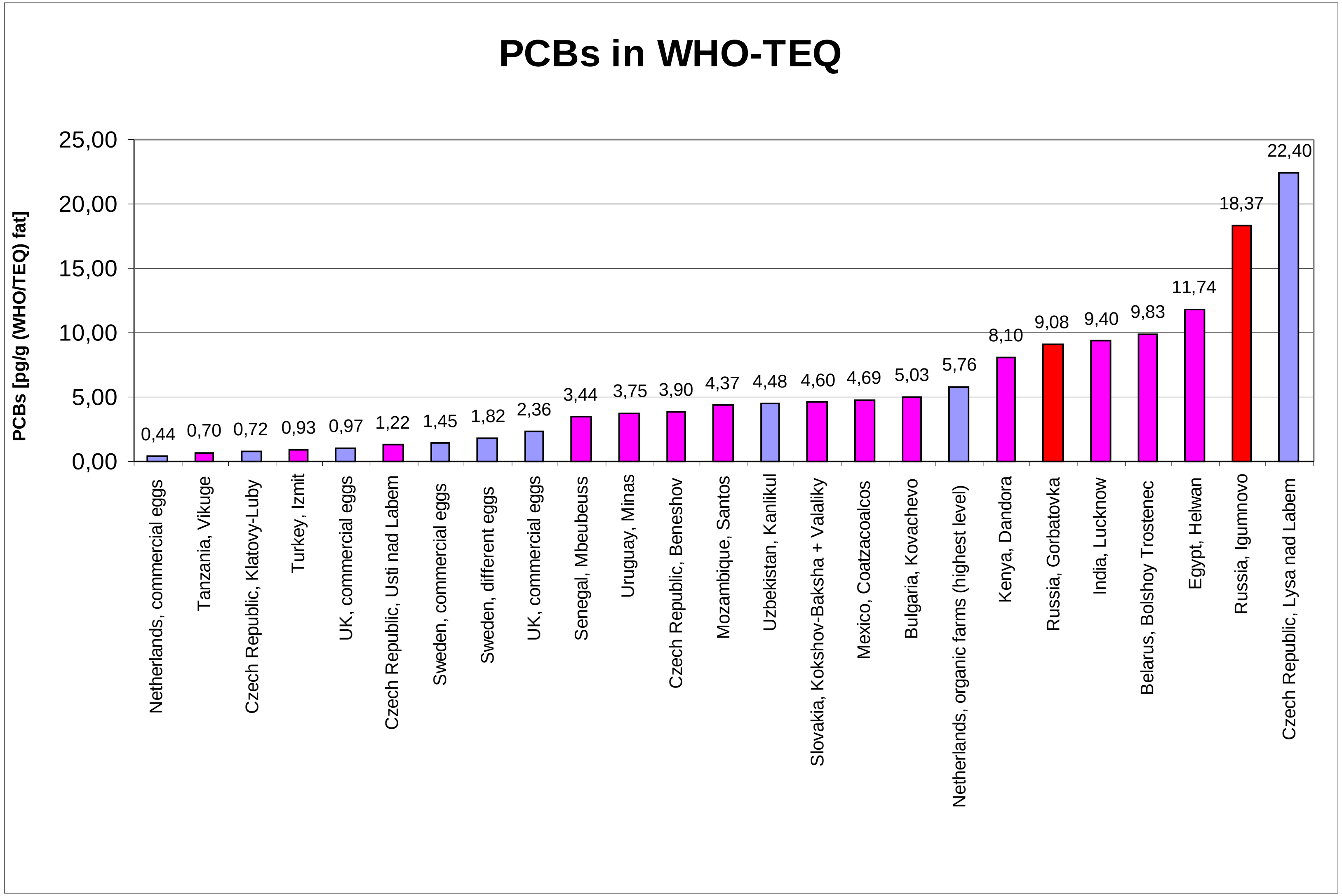
Country	Date/year	Group	Measured level in pg/g (WHO-TEQ) of fat	Source of information
Russia, Gorbatovka	2005	free range	12,68	Axys Varilab 2005
Russia, Chapaevsk	1994	free range	18,10	Sotskov, U. P., Revich, B. A. et al. 2000
Germany	1995	free range	22,80	CLUA Freiburg 1995
UK, Newcastle	2002	free range	26	Pless-Mulloli, T. et al. 2003b
Germany, Rheinfelden	1991	free range	35,70	Malisch, R. et al. 1996
Russia, Igumnovo	2005	free range	44,69	Axys Varilab 2005
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	May-August 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
713.1
514.0
12.7
18.1
22.8
26.0
35.7
44.7
47.1
53.9
64.5
69.2
92.3
121.6
125.6
2.7
6.0
35.3
Russia, Gorbatovka
Russia, Chapaevsk
Germany
UK, Newcastle
Germany, Rheinfelden
Russia, Igumnovo
Germany, Rheinfelden
USA, Oroville
Bulgaria, Kovachevo
USA, Oroville
UK, Pontypool
France, Maincy
Egypt, Helwan
Germany, Rheinfelden
EU (10 countries)
Germany
Germany
Belgium

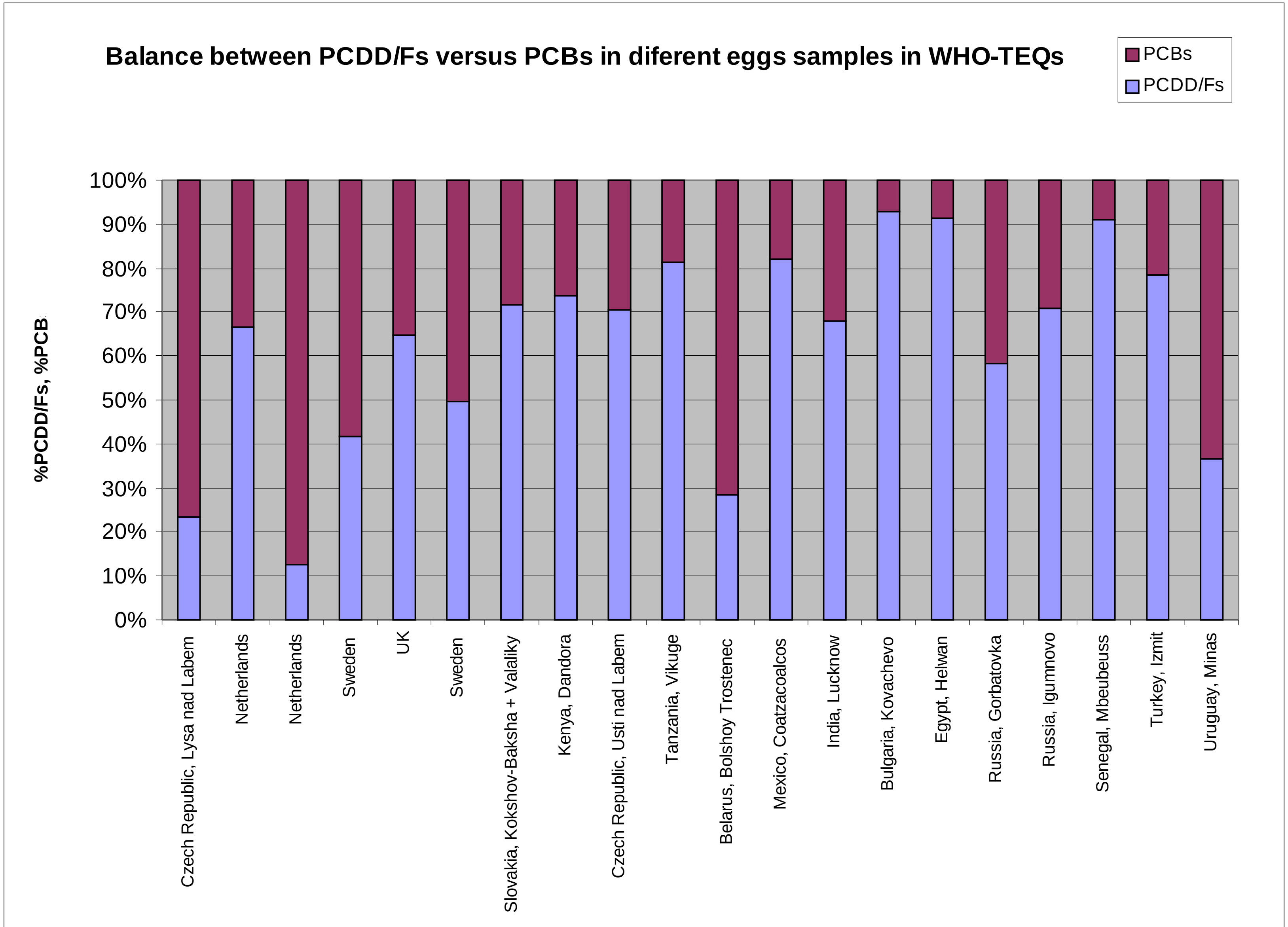
Annex 5: Levels of PCBs in WHO-TEQ in different chicken eggs samples from different parts of world

Country/locality	Year	Group	Number of measured samples	Measured level in pg/g (WHO-TEQ) of fat	Source of information
Netherlands, commercial eggs	1999	not free range	100/2 pools	0,44	SCOOP Task 2000
Tanzania, Vikuge	2005	free range	6/1 pool	0,70	Axys Varilab 2005
Czech Republic, Klatovy-Luby	2003	free range	1	0,72	Beranek, M. et al. 2003
Turkey, Izmit	2005	free range	6/1 pool	0,93	Axys Varilab 2005
UK, commercial eggs	1992	not free range	24/1 pool	0,97	SCOOP Task 2000
Czech Republic, Usti nad Labem	2005	free range	6/1 pool	1,22	Axys Varilab 2005
Sweden, commercial eggs	1999	not free range	32/4 pools	1,45	SCOOP Task 2000
Sweden, different eggs	1993	mixed	84/7 pools	1,82	SCOOP Task 2000
UK, commercial eggs	1982	not free range	24/1 pool	2,36	SCOOP Task 2000
Senegal, Mbeubeuss	2005	free range	6/1 pool	3,44	Axys Varilab 2005
Uruguay, Minas	2005	free range	8/1 pool	3,75	Axys Varilab 2005
Czech Republic, Beneshov	2004	free range	4	3,90	Axys Varilab 2004
Mozambique, Santos	2005	free range	6/1 pool	4,37	Axys Varilab 2005
Uzbekistan, Kanlikul	2001	free range	-	4,48	Muntean, N. et al. 2003
Slovakia, Kokshov-Baksha + Valaliky	2005	free range	6/1 pool	4,60	Axys Varilab 2005
Mexico, Coatzacoalcos	2005	free range	6/1 pool	4,69	Axys Varilab 2005
Bulgaria, Kovachevo	2005	free range	6/1 pool	5,03	Axys Varilab 2005
Netherlands, organic farms (highest level)	2002	free range	6	5,76	Traag, W. et al. 2002
Kenya, Dandora	2004	free range	6/1 pool	8,10	Axys Varilab 2005
Russia, Gorbatovka	2005	free range	4/1 pool	9,08	Axys Varilab 2005
India, Lucknow	2005	free range	4/1 pool	9,40	Axys Varilab 2005
Belarus, Bolshoy Trostenec	2005	free range	6/1 pool	9,83	Axys Varilab 2005
Egypt, Helwan	2005	free range	6/1 pool	11,74	Axys Varilab 2005
Russia, Igumnovo	2005	free range	4/1 pool	18,37	Axys Varilab 2005
Czech Republic, Lysa nad Labem	2004	free range	4/1 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
0,72
0,93
0,97
1,22
1,45
1,82
2,36
3,44
3,75
3,90
4,37
4,48
4,60
4,69
5,03
5,76
8,10
9,08
9,40
9,83
11,74
18,37
22,40
Netherlands, commercial eggs
Tanzania, Vikuge
Czech Republic, Klatovy-Luby
Turkey, Izmit
UK, commercial eggs
Czech Republic, Usti nad Labem
Sweden, commercial eggs
Sweden, different eggs
UK, commercial eggs
Senegal, Mbeubeuss
Uruguay, Minas
Czech Republic, Beneshov
Mozambique, Santos
Uzbekistan, Kanlikul
Slovakia, Kokshov-Baksha + Valaliky
Mexico, Coatzacoalcos
Bulgaria, Kovachevo
Netherlands, organic farms (highest level)
Kenya, Dandora
Russia, Gorbatovka
India, Lucknow
Belarus, Bolshoy Trostenec
Egypt, Helwan
Russia, Igumnovo
Czech Republic, Lysa nad Labem

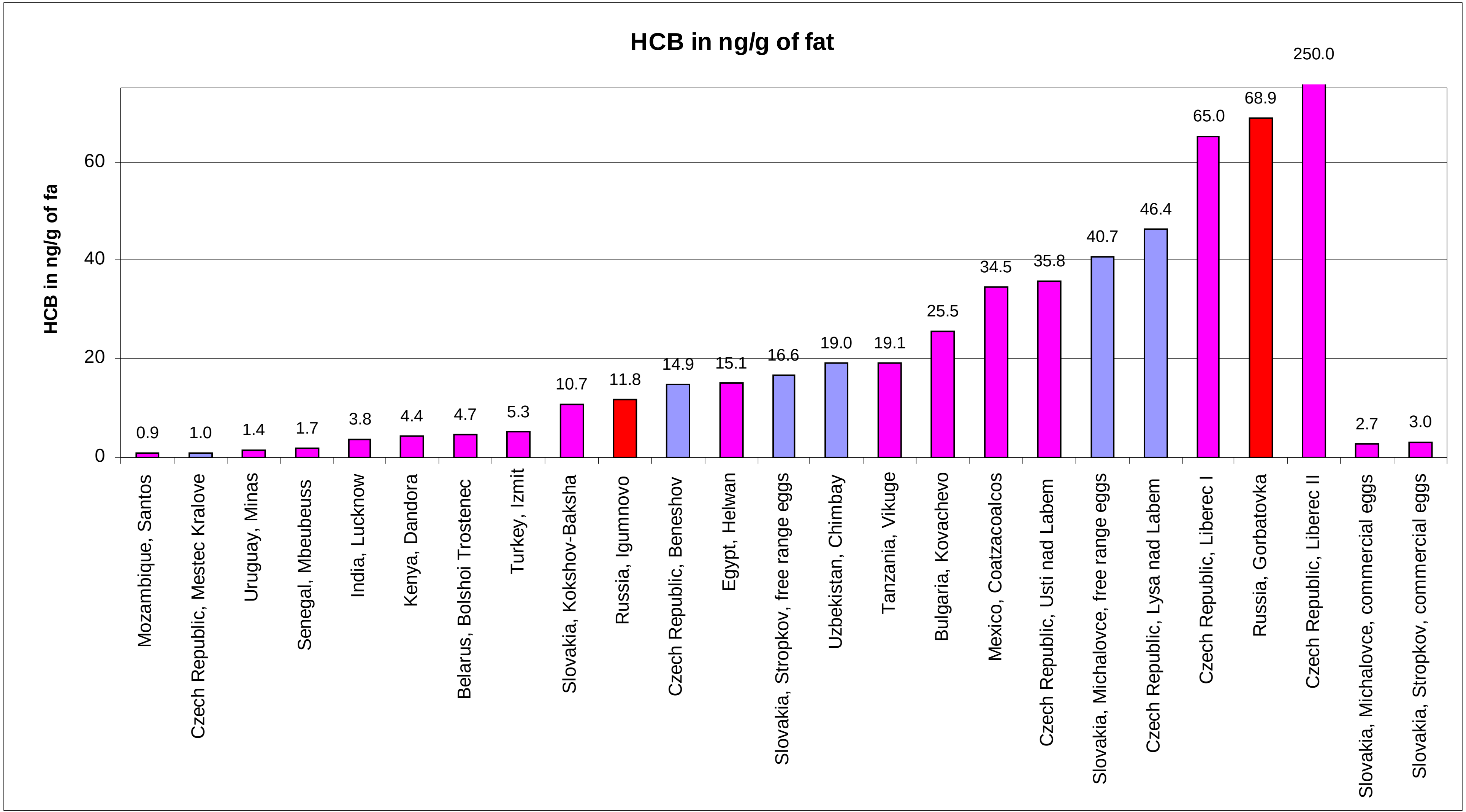
Annex 6: Balance between PCDD/Fs versus PCBs in diferent eggs samples in WHO-TEQs

Country/locality	Year	Group	PCDD/Fs	PCBs	Total WHO-TEQ	Source of information
Czech Republic, 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	0,70	4,89	5,59	Traag, W. et al. 2002
Sweden	1993	mixed	1,31	1,82	3,13	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
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
Bulgaria, Kovachevo	2005	free range	64,54	5,03	69,57	Axys Varilab 2005
Egypt, Helwan	2005	free range	125,78	11,74	137,52	Axys Varilab 2005
Russia, Gorbatovka	2005	free range	12,68	9,08	21,76	Axys Varilab 2005
Russia, Igumnovo	2005	free range	44,69	18,37	63,06	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, %PCB
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Czech Republic, Lysa nad Labem
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
Bulgaria, Kovachevo
Egypt, Helwan
Russia, Gorbatovka
Russia, Igumnovo
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
Mozambique, Santos	2005	free range	6/1 pool	0,9	Axys Varilab 2005
Czech Republic, Mestec Kralove	2003	free range	3	1,0	SVA CR 2004
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
India, Lucknow	2005	free range	4/1 pool	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
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
Russia, Igumnovo	2005	free range	4/1 pool	11,8	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
Bulgaria, Kovachevo	2005	free range	6/1 pool	25,5	Axys Varilab 2005
Mexico, Coatzacoalcos	2005	free range	6/1 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	65,0	Axys Varilab 2005
Russia, Gorbatovka	2005	free range	4/1 pool	68,9	Axys Varilab 2005
Czech Republic, Liberec II	2005	free range	3/1 pool	250,0	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 fa
0
20
40
60
0.9
1.0
1.4
1.7
3.8
4.4
4.7
5.3
10.7
11.8
14.9
15.1
16.6
19.0
19.1
25.5
34.5
35.8
40.7
46.4
65.0
68.9
250.0
2.7
3.0
Mozambique, Santos
Czech Republic, Mestec Kralove
Uruguay, Minas
Senegal, Mbeubeuss
India, Lucknow
Kenya, Dandora
Belarus, Bolshoi Trostenec
Turkey, Izmit
Slovakia, Kokshov-Baksha
Russia, Igumnovo
Czech Republic, Beneshov
Egypt, Helwan
Slovakia, Stropkov, free range eggs
Uzbekistan, Chimbay
Tanzania, Vikuge
Bulgaria, Kovachevo
Mexico, Coatzacoalcos
Czech Republic, Usti nad Labem
Slovakia, Michalovce, free range eggs
Czech Republic, Lysa nad Labem
Czech Republic, Liberec I
Russia, Gorbatovka
Czech Republic, Liberec II
Slovakia, Michalovce, commercial eggs
Slovakia, Stropkov, commercial eggs

Annex 7: Here will be Photos

Photo 1: So called White Sea. The area is large about 50 hectars, and the content is lime sludge, with a high content of chlorinated wastes.

Picture 2: Canal Volosyankha and dumpsite with mixed construction and chemical wastes near Caprolactam factory.

Photo 3: Chickens' house at one of sampling sites in Gorbatovka.

Photo 4: Chickens in their house in Gorbatovka.

Photo 5: Chickens from Igumnovo in their house.

Photo 6: “Black Hole” with chemical waste near Gorbatovka.

Photo 7: Sludge reservoir: wastes production of sulfate ammonium and hydroquinone from factory "Orgsteklo".

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