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## **Contamination of chicken eggs near the hazardous waste incinerator in Izmit, Turkey 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, Bumerang (Turkey), Greenpeace Mediterranean (Turkey) and Arnika Association (Czech Republic)*

*Istanbul - Prague (April - 8 - 2005)*

## **Executive Summary**

Free-range chicken eggs collected near the Izaydas hazardous waste incinerator in Izmit (Turkey) showed levels of dioxins exceeding EU limits for chicken eggs and elevated levels of HCB. The dioxin levels in eggs exceeded background levels by almost 2-fold. HCB levels were five times higher than background levels. To our knowledge, this study represents the first data about U-POPs in chicken eggs from Turkey.

The most obvious potential source of POPs releases at the site is the waste incinerator burning different types of hazardous wastes. The incinerator has operated illegally or under a temporary permit for long time until 2002, when got the permit after having few upgrades to cover the demands of the Ministry of Environment. Its permit was then renewed in 2004 which needs to be renewed this year again as the hazardous wastes directive has changed recently in Turkey.

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. Turkey has signed the Convention in May 2001 but has not ratified it. The Convention mandates Parties to take specific actions aimed at eliminating these pollutants from the global environment. We view the Convention text as a promise to take the actions needed to protect Turkish 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 the Turkish government to ratify the Stockholm Convention and urge 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 Turkey 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 data given by the UNEP Toolkit are not satisfactory;
- 3) Waste incineration of POPs-containing waste should be replaced by alternative technologies or practices that considerably reduce or eliminate the formation of dioxins and other U-POPs. This is promoted in the Stockholm Convention text but somewhat compromised in the proposed documents for COP1 of the Stockholm Convention.
- 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) Turkey should ratify Stockholm Convention.

## Introduction

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

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

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 the hazardous waste incinerator in Izmit was selected as a sampling site since it is known to be a significant source of dioxins and furans and a potential source of hexachlorobenzene as by-products.<sup>1</sup> 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 Turkey.

## Materials and Methods

Please see Annex 1.

## Results and Discussion

### U-POPs in eggs sampled in Izmit, Turkey

The results of the analysis of a pooled sample of 6 eggs collected within a 2 km distance from the hazardous waste incinerator in Izmit are summarized in Tables 1 and 2. Pooled sample fat content was measured at 13.8%.

The sampled eggs exceeded the EU limit for dioxins by 1.13-fold. In addition, the eggs showed elevated levels of HCB. The sum of PCDD/Fs and PCBs is close to the proposed EU limit for total WHO-TEQs.

**Table 1: Measured levels of POPs in the sample from Izmit, Turkey per gram of fat.**

|                           | Measured level | Limits           | Action level     |
|---------------------------|----------------|------------------|------------------|
| PCDD/Fs in WHO-TEQ (pg/g) | 3.37           | 3.0 <sup>a</sup> | 2.0 <sup>b</sup> |
| PCBs in WHO-TEQ (pg/g)    | 0.93           | 2.0 <sup>b</sup> | 1.5 <sup>b</sup> |
| Total WHO-TEQ (pg/g)      | 4.30           | 5.0 <sup>b</sup> | -                |
| PCB (7 congeners) (ng/g)  | 5.13           | 200 <sup>c</sup> | -                |
| HCB (ng/g)                | 5.30           | 200 <sup>d</sup> | -                |

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

<sup>a</sup> 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.

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

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

<sup>d</sup> EU limit according to Council Directive 86/363/EEC.

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

**Table 2: Measured levels of POPs in the sample from Izmit in Turkey per gram of egg fresh weight.**

|                           | Measured level | Limits         | Action level |
|---------------------------|----------------|----------------|--------------|
| PCDD/Fs in WHO-TEQ (pg/g) | 0.47           | 1 <sup>a</sup> | -            |
| PCBs in WHO-TEQ (pg/g)    | 0.13           | -              | -            |
| Total WHO-TEQ (pg/g)      | 0.59           | -              | -            |
| PCBs (7 congeners) (ng/g) | 0.71           | -              | -            |
| HCB (ng/g)                | 0.73           | -              | -            |

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

To our knowledge, the measurements of U-POPs in this study represent the first data on U-POPs in chicken eggs ever reported in Turkey. The levels of dioxins exceeding the EU limits and the elevated level of HCB observed in the egg samples support the need for further monitoring and longer-term changes to eliminate chlorinated chemicals that serve as donors for dioxins and furans releases in all environment compartments. As not all PCDD/Fs releases are fully covered by all relevant documents and/or their drafts prepared under Stockholm Convention, it is very important to cover this gap and develop further the UNEP's Toolkit as well as to introduce stricter rules for handling dioxins containing 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 hazardous waste incinerator in Izmit 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, Kenya, Czech Republic, Belarus, India (Uttar Pradesh), Tanzania, Senegal and Mexico released since 21 March 2005.<sup>2, 3, 4, 5, 6, 7, 8, 9</sup> The dioxin levels in eggs in this study exceed background levels by almost 2-fold (0.2 - 1.2 pg WHO-TEQ/g of fat)

Some other studies showing elevated levels of dioxins include samples with comparable dioxins levels. These were found in eggs from Vikuge in Tanzania and in Klatovy in the Czech Republic<sup>10</sup> (both near obsolete pesticides stockpiles) for example (see chart and graph in Annex 3). Much higher levels were found near an old waste incinerator in Maincy, France<sup>11</sup> and an area affected by a spread mixture of waste incineration residues in Newcastle, UK,<sup>12</sup> with values of 42.47 pg WHO-TEQ/g and 31 pg WHO-TEQ/g respectively.

It is clear that HCB also represents a serious contaminant in the sampled eggs from Izmit, even though it did not exceed the regulatory limits. In fact, eggs from Izmit contained HCB levels that were five times higher than background levels of HCB (1 ng/g of fat).

Concerning the balance between the contribution of PCBs and PCDD/Fs to the whole WHO-TEQ, PCDD/Fs contribute almost 80% of the whole TEQ value in eggs as visible from graph in Annex 5.

## Possible U-POPs sources

The elevated levels of dioxins and hexachlorobenzene in free range chicken eggs in these samples provoke the question of possible sources. As the samples were taken from villages 2 km downwind from the hazardous waste incinerator in Izmit and this waste incinerator is known to be a significant source of dioxins, it is also the most likely to be the biggest contributor to dioxin levels found in this area. On the other hand we can not simply exclude other potential sources such as local heating and/or uncontrolled burning at a waste landfill.

Identifying the source of the hexachlorobenzene is even more difficult as it can have an origin in hazardous wastes as technical chemical and/or in use as pesticide. In addition hazardous waste incinerators can produce HCB as by-product as previously seen in measurements in other countries.<sup>13, 14, 15, 16</sup>

It is clear that there is a gap in publicly accessible data and even existing measurements of U-POPs in Turkey. It is necessary to close this gap to address U-POPs sources properly in the National Implementation Plan of the Stockholm Convention.

## The Izmit Waste and Residue Treatment , Incineration and Recycling Co.Inc. (Izaydas) in Turkey

The Izmit Waste and Residue Treatment, Incineration and Recycling Co.Inc. (Izaydas) was founded in 1996 by the Greater Izmit Municipality within the scope of the Izmit Integrated Environment Project. The company was formed to operate the Clinical and Hazardous Waste Incinerator and the Industrial and Domestic Wastewater Treatment Plant. Both the incinerator, which has an annual capacity of 35,000 tons, and the landfill are located just 2 km from the Solaklar village and only 10 km from the city of Izmit. The landfill has a capacity of 790,000 m<sup>3</sup> of industrial waste and 3,125,000 m<sup>3</sup> of household waste.<sup>17</sup>



Picture 1. Map of the Kocaeli Region and the land use in the area.

The waste incinerator was constructed by the German company Lurgi, with the intention of incinerating a range of wastes (including hazardous wastes) for “power generation”. Hazardous wastes incinerated included:

- outdated herbicides and other pesticides
- cosmetic and pharmaceutical wastes,
- refinery waste and wastes from oil and coal processing plants,
- used lubricants and oil residues,
- soil and dust contaminated with oil,
- solvents and paints,
- resins, glues and pastes,
- plastic and rubber products (including polyester and PVC products ),
- used tires,
- wastes from plastic production and chlorinated residues of plastic products.

Although it was planned to begin operation in August 1997, the Ministry of Environment refused to grant an operating permit on the basis of test burns, arguing that the plant had some technical deficiencies that would lead to emissions of toxic chemicals, especially dioxins and furans. According to information from the construction company, the plant was designed to meet German emission standards from 1986. At the same time, the area within which the industrial wastes and toxic ash from the incinerator would be landfilled did not meet the standards of Hazardous Waste Control Regulations of the Ministry.

The plant operated illegally, without any permit, until action by Greenpeace Mediterranean in the late 1990’s led to an order from the Ministry of Environment to the Kocaeli Governship to stop the transportation of all hazardous wastes to Izaydas and their incineration on site (MoE).

After the Volganefit tanker accident at Marmara sea in December 1999, thousands of tonnes of fuel oil Number six washed on the shores of Istanbul. The oily residues were collected in PVC bags and sent

to Izaydas, despite repeated warnings from Greenpeace to the authorities that collected oil could be recycled and that the burning of PVC would lead to emissions of dioxins.

The company running the incinerator continued to burn waste there, despite the fact that the temporary permit has long expired. However the incinerator was able to get its permit from the ministry in 2002 after having few upgrades to cover the demands of the ministry. Its permit was then renewed in 2004 which needs to be renewed this year again as the hazardous wastes directive has changed recently in Turkey.

## **POPs in the environment of the Izmit and surrounded areas**

On 5 April 2000, representatives of Greenpeace Mediterranean and Greenpeace International visited the incinerator compound and were permitted to collect a total of four samples of ash, taken from different sections of the installation:

- MI0064 — bottom ash from the combustion chamber
- MI0065 — ash from economiser / heat exchanger;
- MI0065/66 — fly ash from electrostatic precipitator (ESP).

All samples were analysed at the Greenpeace Research Laboratories, University of Exeter (UK), for heavy metal and organic contaminants. Two samples (MI0065, ESP ash; MI0067, economiser ash) were forwarded to an accredited laboratory for determination of concentrations of polychlorinated dibenzo-p-dioxins and dibenzofurans. Results were summarised in a Greenpeace study.<sup>18</sup>

With respect to organic contaminants, the greatest number were isolated from the bottom ash collected from the incinerator furnace, indicative of incomplete combustion of some components of the waste feedstock (see Table 2). Among the numerous aromatic organic compounds identified were 1,4-dichlorobenzene and two polychlorinated biphenyls (PCBs), though the latter were only detectable using selective ion monitoring. Although they can be produced as products of incomplete combustion in incinerators, their presence in the bottom ash residues strongly suggests the inclusion of PCBs or PCB-contaminated materials in the incinerator feedstock.

The presence of chlorinated contaminants in the ESP ash was further confirmed by the results of the dioxin analysis for this sample (280 pg I-TEQ/g, ppt).

Dioxins were also detectable in the ash from the economiser/ heat exchanger boiler, located between the furnace and the ESP, although at substantially lower concentrations (8.2 pg I-TEQ/g) than in the ESP fly ash.

It is worth noting that, in addition to chlorinated dioxins, it is also likely that other halogenated dioxins and furans are present in the incinerator ashes, and flue gases, such as brominated and mixed chlorinated/brominated compounds.

The results of the study also indicate that PCBs, or PCB-contaminated wastes, formed a significant part of the feedstock of the Izmit incinerator. This would appear to be in direct contradiction to the condition in the temporary operating permit from the Municipality that the incinerator should not handle chlorinated wastes. The incinerator was also clearly operating in April 2000, long after the temporary permit had first been issued as an emergency measure. Moreover, the appearance of PCB residues in the bottom ash is strongly indicative of inefficient and incomplete combustion of wastes within the furnace.

## 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. Turkey signed the Convention in 2001 but has not ratified it.

The Convention mandates Parties to take specific actions aimed at eliminating these pollutants from the global environment. Parties are to require the use of substitute or modified materials, products and processes to prevent the formation and release of U-POPs.<sup>a</sup> 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).<sup>b</sup> In addition, Parties are to promote both BAT and best environmental practices (BEP) for all new and existing significant source categories,<sup>c</sup> 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.<sup>d</sup> 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 Turkish 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 Turkish governmental representatives and all stakeholders to honor the integrity of the Convention text and keep the promise of reduction and elimination of POPs.

Generally, it should be also noted that a range of alternative (non-combustion) technologies already exist for the destruction of PCB stockpiles and PCB contaminated wastes, as well as other hazardous wastes. Several are already in commercial operation, handling PCBs and other chlorinated wastes. Alternatives to incineration also exist for sterilisation of clinical wastes, including autoclaves and microwave systems. Such systems destroy pathogens on all surfaces of the clinical waste materials without the need to destroy the waste material itself, thereby avoiding the formation of dioxins during incineration.

In selecting appropriate alternative destruction technologies for hazardous chemical wastes, a key criterion should be the ability to operate the process in closed-loop configuration, such that any waste streams which may contain hazardous residues may be re-circulated back through the process. It is only in this matter that the objective to eliminate the generation and output of hazardous by-products of destruction, including dioxins, may be achieved. Incinerator and related combustion technologies can never be operated in such a closed-loop configuration.

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<sup>a</sup> Article 5, paragraph (c)

<sup>b</sup> Article 5, paragraph (d)

<sup>c</sup> Article 5, paragraphs (d) & (e)

<sup>d</sup> Article 5, paragraph (a), subparagraph (i)

# Annex 1. Materials and Methods

## Sampling

For sampling in Turkey, we have chosen the surroundings of the hazardous waste incinerator Izaydas located in the Kocaeli region.

The eggs were collected from 3 different chicken fanciers at the same village, Solaklar, and one from the neighbor village, Durhasan. The hens from which the eggs were picked were all free-range of age between 4 months to 1 year although regularly provided with home food supplements - wheat, barley, oats, maize. Chicken fanciers grow these feedings by themselves.

Sampling was done by local activists on behalf of Arnika Association on 19 January 2005. Four chicken fanciers supplied 12 eggs from their free range chickens. The eggs were kept in cool conditions after sampling and then were boiled in Turkey for 7 - 10 minutes in pure water and transported to the laboratory at ambient temperature.

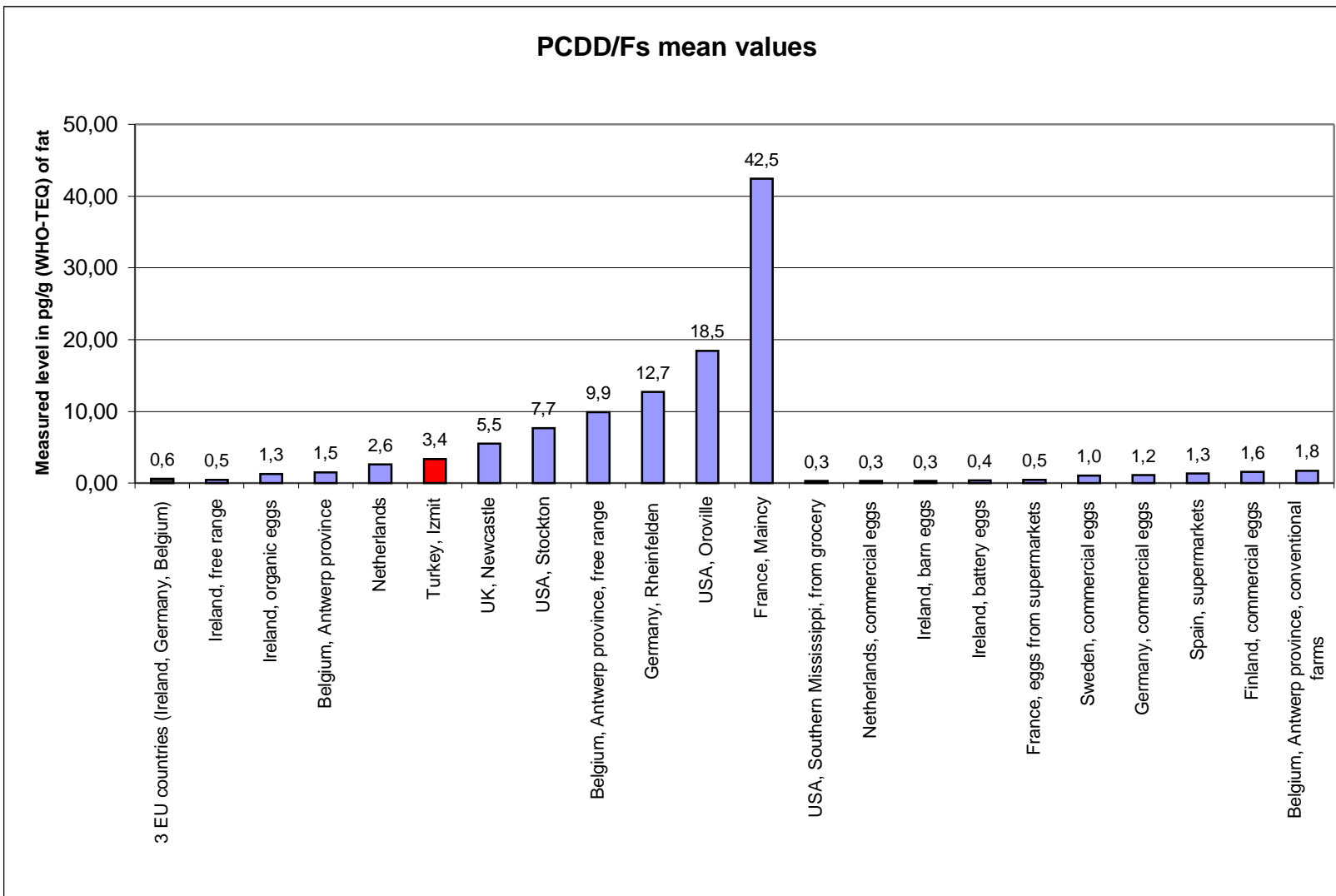
## Analysis

After being received by the laboratory, the eggs were kept frozen until analysis. The egg shells were removed and the edible contents of 6 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<sub>2</sub>SO<sub>4</sub>, NaOH and AgNO<sub>3</sub>. 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.<sup>a</sup> 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.

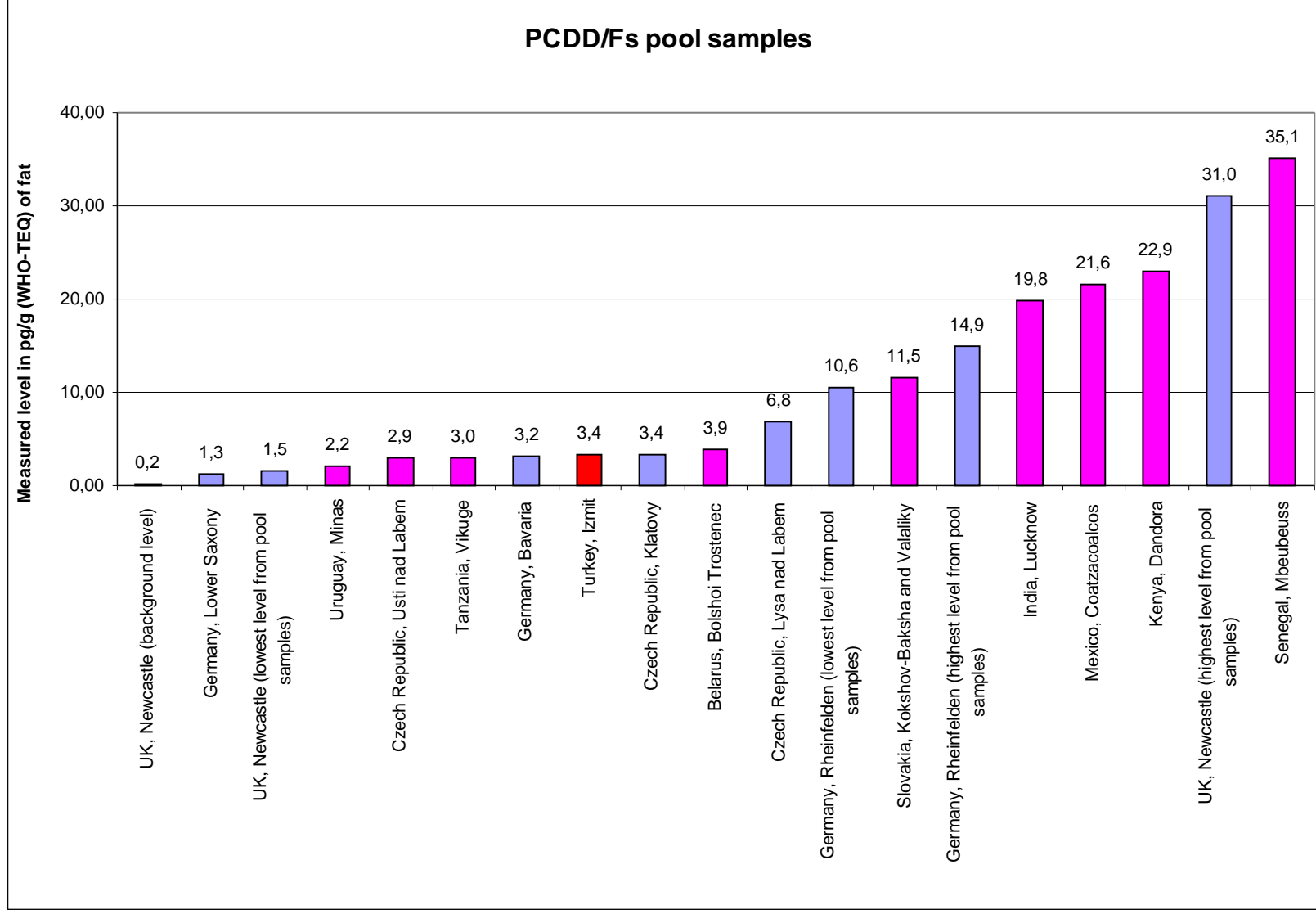
## Annex 2: Mean values found within different groups of eggs from different parts of world

| 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                        |
| <b>Turkey, Izmit</b>                          | <b>2005</b> | <b>free range</b> | <b>3,37</b>                             | <b>Axys Varilab 2005</b>         |
| 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       |



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

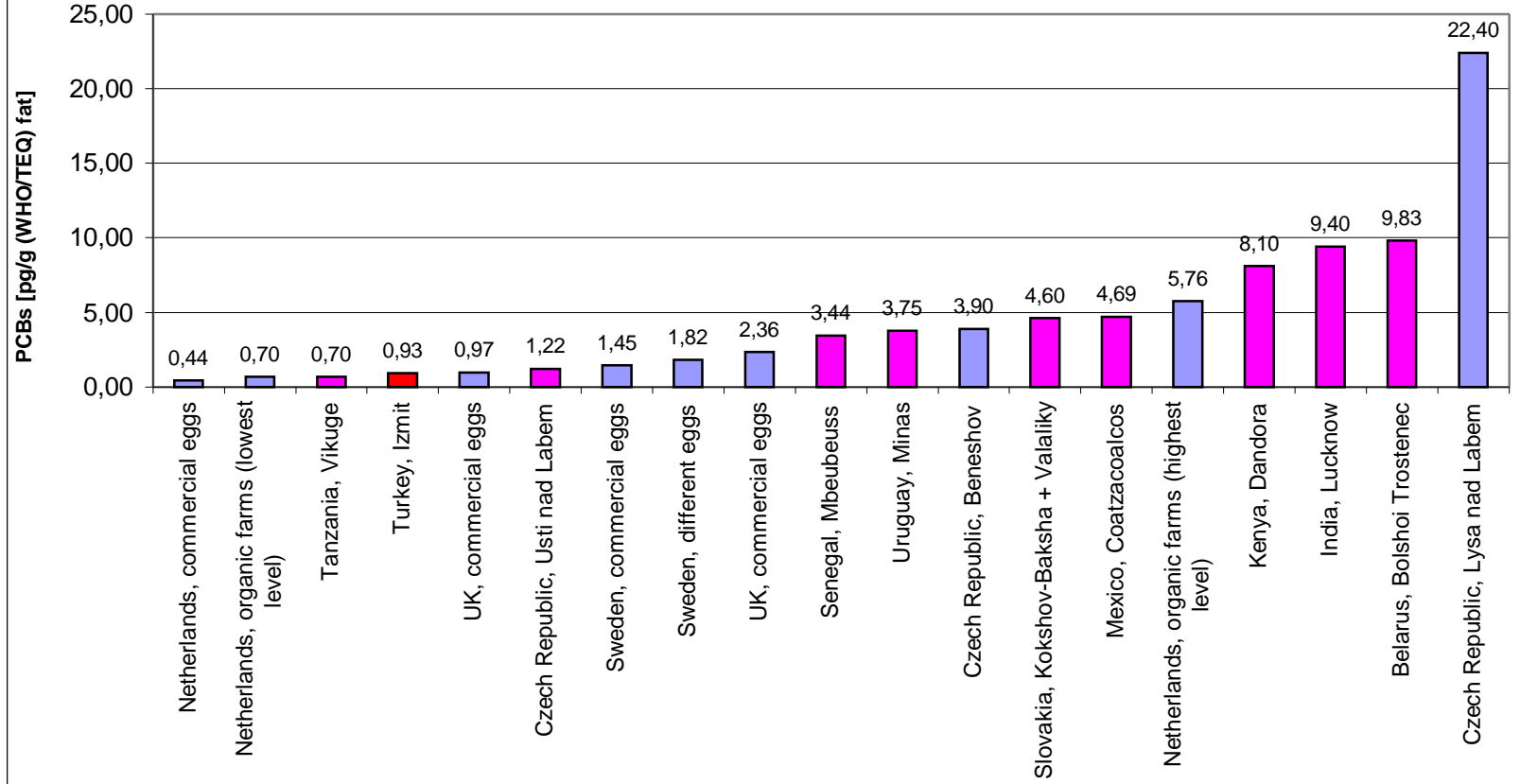
| Country/locality                                       | Year | Group      | Number of eggs/measured in pg/g (WHO-samples) | Measured level (WHO-TEQ) of fat | Source of information         |
|--|------|------------|---|---------------------------------|-------------------------------|
| UK, Newcastle (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 |
| Uruguay, Minas   | 2005 | free range |   | 2,18                            | Axys Varilab 2005             |
| Czech Republic, Usti nad Labem                         | 2005 | free range | 6/1 pooled                                    | 2,90                            | Axys Varilab 2005             |
| Tanzania, Vikuge                                       | 2005 | free range | 6/1 pooled                                    | 3,03                            | Axys Varilab 2005             |
| Germany, Bavaria                                       | 1992 | free range | 370/37 pools                                  | 3,20                            | SCOOP Task 2000               |
| Turkey, Izmit  | 2005 | free range |   | 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 pooled                                    | 3,91                            | Axys Varilab 2005             |
| Czech Republic, Lysa nad Labem                         | 2004 | free range | 4   | 6,80                            | Petriik, J. 2005              |
| Germany, Rheinfelden (lowest level from pool samples)  | 1996 | free range | -   | 10,60                           | Malisch, R. et al. 1996       |
| Slovakia, Kokshov-Baksha and Valaliky                  | 2005 | free range | 6/1 pooled                                    | 11,52                           | Axys Varilab 2005             |
| Germany, Rheinfelden (highest level from pool samples) | 1996 | free range | -   | 14,90                           | Malisch, R. et al. 1996       |
| India, Lucknow   | 2005 | free range | 4/1 pooled                                    | 19,80                           | Axys Varilab 2005             |
| Mexico, Coatzacoalcos                                  | 2005 | free range | 6/1 pooled                                    | 21,63                           | Axys Varilab 2005             |
| Kenya, Dandora   | 2004 | free range | 6/1 pooled                                    | 22,92                           | Axys Varilab 2005             |
| UK, Newcastle (highest level from pool samples)        | 2000 | free range | 3/1 pooled                                    | 31,00                           | Pless-Mulloli, T. et al. 2001 |
| Senegal, Mbeubeuss                                     | 2005 | free range |   | 35,10                           | Axys Varilab 2005             |



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

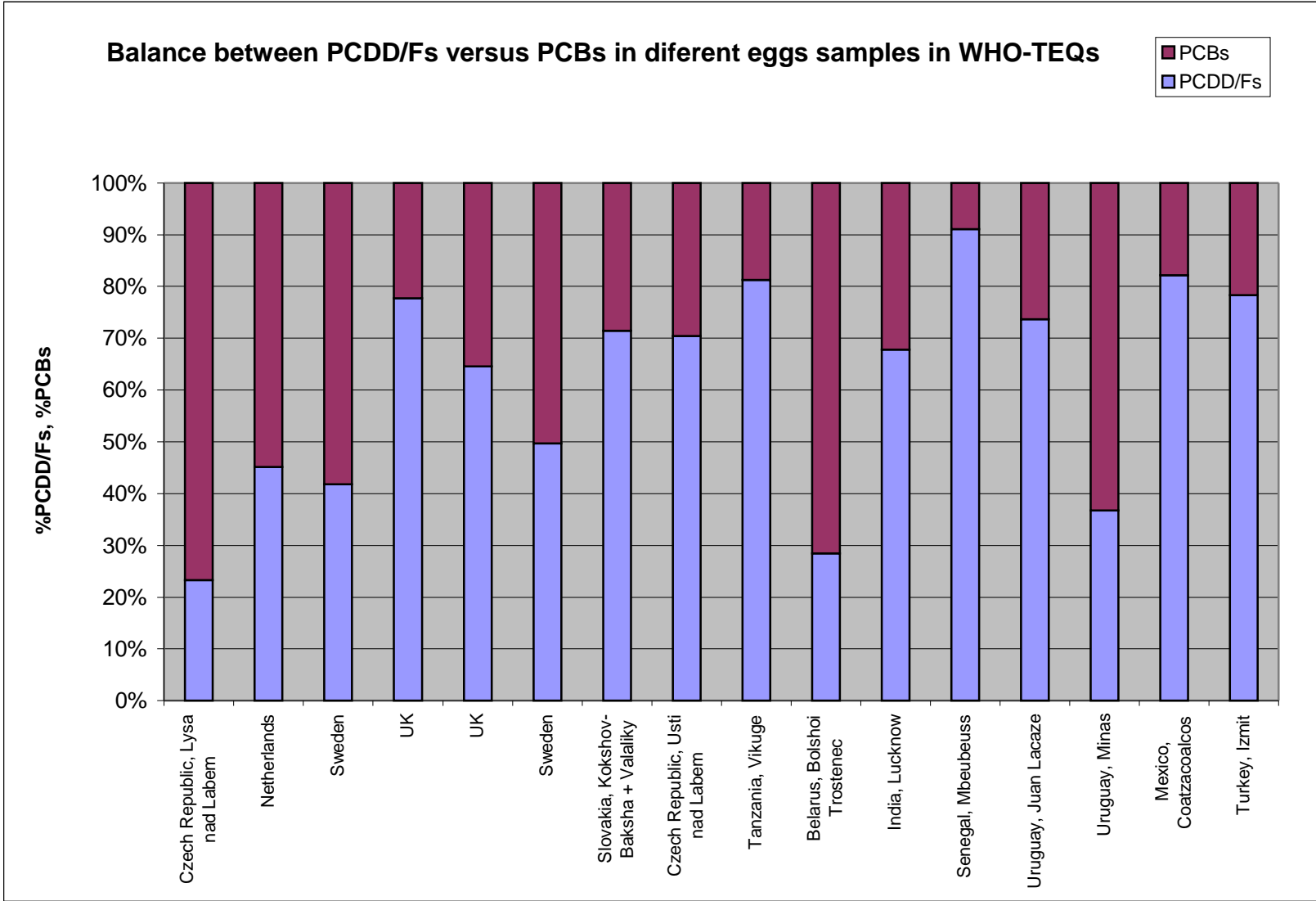
| Country/locality                           | Year | Group          | Number of measured samples | Specification       | Measured level in pg/g (WHO-TEQ) of fat | Source of information |
|--|------|----------------|----------------------------|---------------------|---|-----------------------|
| Netherlands, 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 |
| Tanzania, Vikuge                           | 2005 | free range     | 6/1 pool                   | pool                | 0,70                                    | Axys Varilab 2005     |
| Turkey, Izmit                              | 2005 | free range     |                            | pool                | 0,93                                    | Axys Varilab 2005     |
| 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       |
| Sweden, different eggs                     | 1993 | mixed          | 84/7 pools                 | pool                | 1,82                                    | SCOOP Task 2000       |
| UK, commercial eggs                        | 1982 | not free range | 24/1 pool                  | pool                | 2,36                                    | SCOOP Task 2000       |
| Senegal, Mbeubeuss                         | 2005 | free range     |                            | pool                | 3,44                                    | Axys Varilab 2005     |
| Uruguay, Minas                             | 2005 | free range     |                            | pool                | 3,75                                    | Axys Varilab 2005     |
| Czech Republic, Beneshov                   | 2004 | free range     | 4                          | pool                | 3,90                                    | Axys Varilab 2004     |
| Slovakia, Kokshov-Baksha + Valaliky        | 2005 | free range     | 6/1 pool                   | pool                | 4,60                                    | Axys Varilab 2005     |
| Mexico, Coatzacoalcos                      | 2005 | free range     | 6/1 pooled                 | 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 pooled                 | pool                | 9,40                                    | Axys Varilab 2005     |
| Belarus, Bolshoi Trostenech                | 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



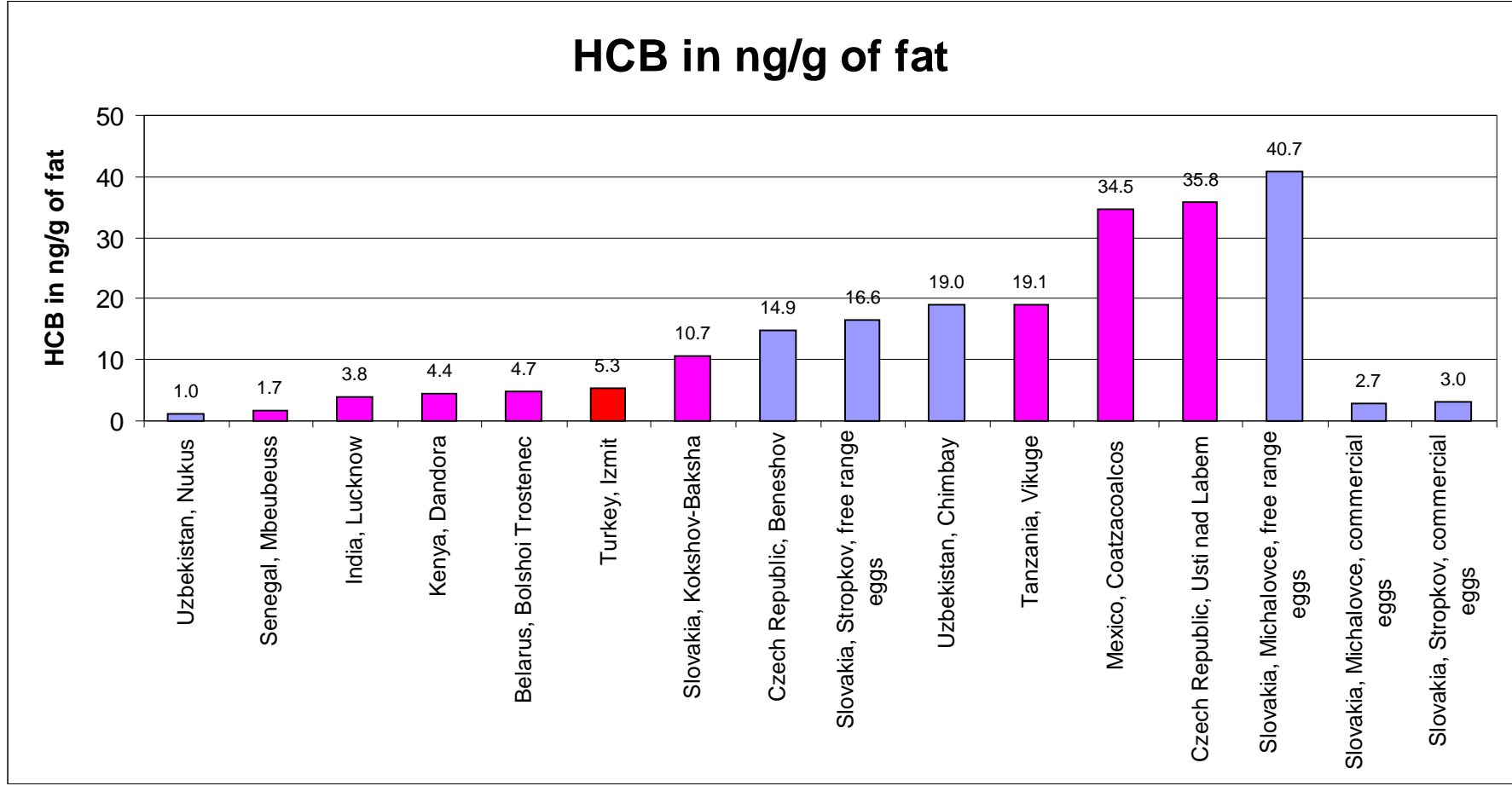
## Annex 5: Balance between PCDD/Fs versus PCBs in different eggs samples in WHO-TEQs

| Country/locality                    | Year | Group          | PCDD/Fs | PCBs  | Total WHO-TEQ | Source of information |
|-------------------------------------|------|----------------|---------|-------|---------------|-----------------------|
| Czech Republic, Lysa nad Labem      | 2004 | free range     | 6,80    | 22,40 | 29,20         | Petrlik, J. 2005      |
| Netherlands                         | 2002 | free range     | 4,74    | 5,76  | 10,50         | Traag, W. et al. 2002 |
| Sweden                              | 1993 | mixed          | 1,31    | 1,82  | 3,13          | SCOOP Task 2000       |
| UK                                  | 1982 | not free range | 8,25    | 2,36  | 10,61         | SCOOP Task 2000       |
| UK                                  | 1992 | not free range | 1,77    | 0,97  | 2,74          | SCOOP Task 2000       |
| Sweden                              | 1999 | not free range | 1,43    | 1,45  | 2,48          | SCOOP Task 2000       |
| Slovakia, Kokshov-Baksha + Valaliky | 2005 | free range     | 11,52   | 4,60  | 16,12         | Axys Varilab 2005     |
| Czech Republic, Usti nad Labem      | 2005 | free range     | 2,90    | 1,22  | 4,12          | Axys Varilab 2005     |
| Tanzania, Vikuge                    | 2005 | free range     | 3,03    | 0,70  | 3,73          | Axys Varilab 2005     |
| Belarus, Bolshoi Trostenec          | 2005 | free range     | 3,91    | 9,83  | 13,74         | Axys Varilab 2005     |
| India, Lucknow                      | 2005 | free range     | 19,80   | 9,40  | 29,20         | Axys Varilab 2005     |
| Senegal, Mbeubeuss                  | 2005 | free range     | 35,10   | 3,44  | 38,54         | Axys Varilab 2005     |
| Uruguay, Juan Lacaze                | 2005 | free range     | 2,49    | 0,89  | 3,38          | Axys Varilab 2005     |
| Uruguay, Minas                      | 2005 | free range     | 2,18    | 3,75  | 5,93          | Axys Varilab 2005     |
| Mexico, Coatzacoalcos               | 2005 | free range     | 21,63   | 4,69  | 26,32         | Axys Varilab 2005     |
| Turkey, Izmit                       | 2005 | free range     | 3,37    | 0,93  | 4,30          | Axys Varilab 2005     |



## Annex 6: 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   |
|---------------------------------------|-------------|----------------|----------------------------|-------------------------------|-------------------------|
| Uzbekistan, Nukus                     | 2001        | free range     | -                          | 1,0                           | Muntean, N. et al. 2003 |
| Senegal, Mbeubeuss                    | 2005        | free range     |                            | 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     |                            | 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       |
| 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       |
| Czech Republic, Usti nad Labem        | 2005        | free range     | 6/1 pool                   | 35,8                          | Axys Varilab 2005       |
| Slovakia, Michalovce, free range eggs | before 1999 | free range     | 1                          | 40,7                          | Kocan, A. et al. 1999   |
| Slovakia, Michalovce, commercial eggs | before 1999 | not free range | 1                          | 2,7                           | Kocan, A. et al. 1999   |
| Slovakia, Stropkov, commercial eggs   | before 1999 | not free range | 1                          | 3,0                           | Kocan, A. et al. 1999   |



## 7: Photos

Photo 1: View at the incinerator from sampling place. Photo by: Greenpeace & Bumerang.



**Photo 2:** Chicken at sampling place in Izmit.. Photo by: Greenpeace & Bumerang.



**Photo 3:** Sampled free range chicken eggs. Photo by: Greenpeace & Bumerang.



**Photo 4:** Sampling procedure in Izmit. Photo by: Greenpeace & Bumerang.



**Photo 5:** Free range chicken at sampling site with waste incinerator behind. Photo by: Greenpeace & Bumerang.



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