SCIENTIFIC REPORT OF EFSA

Update of the monitoring of levels of dioxins and PCBs in food and feed[1]

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ABSTRACT

Dioxins and polychlorinated biphenyls (PCBs) are environmentally persistent substances that have been associated with human health effects. Their presence in food and feed available on the European market is monitored. A total of 13,797 samples were assessed for dioxins and dioxin-like PCBs (DL-PCBs) and 19,181 samples for non dioxin-like PCBs (NDL-PCBs). These samples were submitted between 1995 and 2010 by 26 European countries. At least one quantified congener of dioxins and DL-PCBs was found in almost all samples, whereas at least one NDL-PCB indicator was quantified in 68.4 % of the feed and 82.6 % of the food samples. “Meat from eels” and “Fish liver and derived products” contained the highest average contamination levels of both dioxins and PCBs. Levels of dioxins and DL-PCBs, and of NDL-PCBs were above the permitted maximum levels in respectively 10 % and 3 % of the food samples. Depending on the population group, defined as the combination of age class and the respective survey, average exposure to dioxins and DL-PCBs was estimated to be between 0.57 and 2.54 pg TEQ_{WHO05}/kg b.w. per day and the 95th percentile between 1.2 and 9.9 pg TEQ_{WHO05}/kg b.w. per day. Average exposure to NDL-PCB indicators was estimated to be between 4.3 and 25.7 ng/kg b.w. per day and the 95th percentile between 7.8 and 53.7 ng/kg b.w. per day. Fish, meat and dairy products appeared to be the highest contributing food groups to dietary exposure. Their relative importance depended on age and country of the consumer. A general decrease in dietary exposure of dioxins and DL-PCBs was observed between 2002-2004 and 2008-2010, estimated to be between 16.6 % and 79.3 % for the different population groups. A smaller decrease was observed for NDL-PCBs. Full compliance with legislative requirements for analysis and reporting would facilitate future Europe-wide risk assessments.

KEY WORDS

(Polychlorinated biphenyls (PCB), dioxins, food, feed, occurrence, exposure)

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SUMMARY

Dioxins and polychlorinated biphenyls (PCBs) are toxic chemicals that persist in the environment and accumulate in the food chain. They can cause adverse effects on the nervous, immune and endocrine systems, impair reproductive function and may cause cancer. Because of potential high dietary exposure in some population groups, dioxins and PCBs represent an important public health issue at the European level.

A community strategy for dioxins and PCBs was adopted by the Commission on 24 October 2001, addressing measures to limit or to eliminate their emission into the environment through source-directed measures and addressing the way to actively decrease the presence of dioxins and PCBs in food and feed.

Results from national monitoring programs on the presence of dioxins and PCBs in food and feed were reported to the Commission on a regular basis. In 2010, EFSA received the mandate from the European Commission to collect and analyse, on a continuous basis, all available data on dioxins and PCBs in food and feed. The mandate includes the publication of a report every two years analysing these data.

A total of 13,797 samples for dioxins and dioxin-like PCBs (DL-PCBs) and 19,181 samples for non dioxin-like PCBs (NDL-PCBs), collected between 1995 and 2010 from 24 European Union Member States, Iceland and Norway, were considered for a detailed assessment.

At least one quantified congener of dioxins and DL-PCBs was found in almost all feed and food samples analysed, whereas at least one of the six NDL-PCB indicators was quantified in respectively 68.4 % and 82.6 % of the feed and food samples. Feed and food from animal origin contained higher levels of dioxins and PCBs than foods of plant origin. “Meat from eels” and “Fish liver and derived products” contained the highest average contamination levels for both dioxins and PCBs.

The non-*ortho* PCBs was the main contributor to the total toxicity equivalents (TEQ_{WHO05}) of dioxins and DL-PCBs, representing between 21.0 and 74.5 % of the total TEQ_{WHO05} level, followed by the polychlorinated dibenzo-p-dioxins (PCDDs) and the polychlorinated dibenzofurans (PCDFs), which together represented between 12.4 and 73.2 % of the total TEQ level. Concerning the NDL-PCBs, the PCB-153, followed by PCB-138 and PCB-180 represented altogether between 36.9 and 97.8 % of the sum of the six NDL-PCB indicators depending on the food and feed group.

The level of dioxins and DL-PCBs exceeded the permitted maximum level (ML) in 9.7 % of the food samples and 2.3 % of the feed samples. The level of the six NDL-PCB indicators exceeded the ML in 3.0 % of the food samples and 2.4 % of the feed samples.

A decrease in the contamination levels of dioxins and PCBs was observed over the years in the three food groups taken into consideration for the time trend analysis: “Raw milk and dairy products”, “Hen eggs and egg products” and “Muscle meat from fishes other than eels”.

The six NDL-PCB indicators were found to represent around 50 % of the sum of the NDL-PCBs which were measured in the food samples. Levels of the six NDL-PCB indicators and DL-PCBs were positively correlated in all food and feed groups. The correlation level was depending on the food groups and sometimes influenced by outliers.

Subgroup analysis revealed that meat from sheep contained on average less dioxins and PCBs than meat from bovine animals. Eggs coming from battery rearing contained significantly less dioxins and PCBs than those coming from free range, organic and outdoor growing production. Farmed salmon and trout contained on average less dioxins and PCBs than wild-caught salmon and trout. Herring, salmon and trout coming from the Baltic region were more contaminated by dioxins and PCBs than those coming from other regions. Milk at farms had higher levels of dioxins and DL-PCBs than milk from bulk, whereas the inverse was observed for the NDL-PCB indicators.

Chronic dietary exposure was assessed for 68 population groups across the different European dietary surveys collated in the EFSA Comprehensive European Food Consumption Database, representing 7 age classes (infant, toddler, other children, adolescent, adult, elderly and very elderly) in up to 17 Member States.

Depending on the population group (i.e. combination of the age class and survey), the average exposure to the sum of dioxins and DL-PCBs was estimated to be between 0.57 and 2.54 pg TEQ_{WHO05}/kg b.w. per day and the 95th percentile was between 1.2 and 9.9 pg TEQ_{WHO05}/kg b.w. per day. The percentage of individuals exposed above the Tolerable Weekly Intake (TWI) of 14 pg TEQ/kg b.w. was estimated to be between 1.0 and 52.9 %. The major contributor to total exposure was the food category of milk and dairy products for almost all groups of infants and toddlers, whereas it was fish and seafood for most of the groups of adolescent, adult, elderly and very elderly. Meat and meat products also contributed significantly to total exposure. A general decrease in exposure to the sum of dioxins and DL-PCBs of between 16.6 % and 79.3 % across the different population groups was observed when comparing 2002-2004 data with data from 2008-2010.

Average exposure to the sum of the six NDL-PCB indicators was estimated to be between 4.3 and 25.7 ng/kg b.w. per day and at the 95th percentile between 7.8 and 53.7 ng/kg b.w. per day, depending on the population group. The major contributor to total exposure was either the food category fish and seafood products or meat and meat products in the groups of adolescent, adult, elderly and very elderly. It was followed by milk and dairy products and animal and vegetable oils and fats. For some groups of infants, toddlers and other children, milk and dairy products and/or foods for infants and young children were the major contributors to total exposure. In the other children groups, the pattern was similar to exposure observed for groups of adolescents or adults of the same country. When comparing 2002-2004 data with data from 2008-2010, a decrease in the dietary exposure was observed in almost all (61/68) population groups, estimated to be between 2.0 and 75.6 %.

The time trends identified might be attributed to European risk management measures to reduce exposure in the European population, but could also in part be due to improvements of the analytical methods and sampling designs of the monitoring programs over the years.

The current results should be interpreted with caution because some of the occurrence data originated from targeted monitoring programs, which might have led to overestimation of the actual food contamination and thus to overestimation of exposure of the population. On the other hand, the exclusion of some foods from the exposure assessment may have led to underestimation of total exposure for some population groups. Finally, since the occurrence data from all countries have been merged without any adjustment of their representativeness, the contamination, exposure and time trend estimates may not reflect the actual situation for the different population groups.

In order to improve the accuracy of the assessment of food contamination levels and exposure to dioxins and PCBs throughout Europe, it is important to clearly define the sampling strategy used both at the sample level and for the overall direction of monitoring programs. Results should be reported with a clear indication of the unit expressing the results (e.g. on fat, whole weight or moisture basis), as this greatly affects the estimation of the contamination levels of food and feed to dioxins and PCBs. It is suggested to measure dioxins and PCBs in food and feed samples according to minimum specified analytical performance criteria and to target those foods identified as main contributor to the total exposure of the population, but for which the estimations of the contamination levels were not robust.

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BACKGROUND AS PROVIDED BY THE EUROPEAN COMMISSION

In recent years, the European Food Safety Authority (EFSA) has adopted many scientific opinions related to undesirable substances in feed and on nitrates, non-dioxin like PCBs and certain mycotoxins in food. For some of these opinions, specific data collection exercises have been launched. In the frame of official control and monitoring more occurrence data is being generated. It is appropriate that these data are collected into one database, collated and analysed. Article 23 (and 33) of Regulation (EC) No 178/2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety[4], entrusts EFSA with this task.

The integration of newly generated data into existing databases on occurrence data (e.g. dioxins and PCBs) in the field of contaminants in feed and food on a permanent basis will ensure continuity of data collection. This would enable EFSA to access accurate data when quick action is required to handle urgent requests for scientific opinions/statements e.g. in case of contamination incidents and/or requests for scientific opinions where scientific assessments are needed within a short period and separate calls for data would require too much time.

Furthermore, it is expected that the set up of these permanent data collection exercises will stimulate the generation of occurrence data and their electronic transmission in accordance with the standard sample description for feed and food (EFSA, 2010a).

The permanent data collection exercises could in principle encompass the whole field of contaminants in feed and food. However, to focus the work it is appropriate also for the competent authorities and stakeholder organisations, which have to provide the data, to identify specific topics for which a permanent occurrence data collection exercise is to be set up. Several requests for data collections were already addressed by the Commission to EFSA e.g. on heavy metals, furan, acrylamide in food, etc. In annex to this request, several topics that have not yet been the subject of a specific request are identified with an indication of priority/importance for the Commission services.

TERMS OF REFERENCE AS PROVIDED BY THE EUROPEAN COMMISSION

The following tasks are related to data collection:

- publication of a report on a regular basis (every 2 years) per topic. The report should contain, besides an analysis of the received data, also recommendations for improving data collection on this topic and ensure, in co-operation with the Commission services, the appropriate follow up to these recommendations;
- provide assistance/support/information to the Commission services based on ad hoc requests related to the occurrence data present in the database. Such requests might involve negotiations of timelines should they require the use of significant resources from EFSA.

[4] Regulation (EC) No 178/2002 of the European parliament and of the Council of 28 January2002 laying down the general principles and requirements of food law, establishing the European Food SafetyAuthority and laying down procedures in matters of food safety. OJ L 31, 1.2.2002, p. 1-24.

ASSESSMENT

1. Introduction

Dioxins and polychlorinated biphenyls (PCBs) are toxic chemicals that persist in the environment and accumulate in the food chain. They can cause adverse effects on the nervous, immune and endocrine systems, impair reproductive function and may cause cancer. Because of potential high dietary exposure in some population groups, dioxins and PCBs represent an important public health issue at the European level.

The term "dioxins" refers more specifically to two groups of tricyclic planar compounds, the polychlorinated dibenzo-p-dioxins (PCDDs) and the polychlorinated dibenzofurans (PCDFs). Depending on the number of chlorine atoms and their positions at the rings, 75 PCDDs and 135 PCDFs, termed "congeners", can occur. Dioxins are generated in a number of thermal and industrial processes as unwanted and often unavoidable impurities or by-products. Important emission sources are, inter alia, metal production and processing, waste incineration and domestic furnaces. However, due to a number of regulatory measures since the 1980s, the emission of dioxins into the environment has decreased considerably.

PCBs are a group of organochlorine compounds that are synthesized by catalysed chlorination of biphenyl. Depending on the number of chlorine atoms and their position, there are 209 theoretically possible congeners. In contrast to dioxins, PCBs had widespread use in numerous industrial applications, due to their physical and chemical properties, such as non-flammability, chemical stability, high boiling point, low heat conductivity and high dielectric constants. They were massively produced for over four decades, from 1929 until they were banned in the 1980s. Based on structural characteristics and toxicological effects, PCBs can be divided into two groups. One group consists of 12 congeners that easily can adopt a coplanar structure and show toxicological properties similar to dioxins. This group is therefore often termed 'dioxin-like PCBs' (DL-PCBs). Most other PCBs do not show dioxin-like toxicity and are therefore termed 'non dioxin-like PCBs' (NDL-PCBs). Among the NDL-PCBs, six are considered as appropriate indicators for different PCB patterns in various sample matrices: PCB-28, -52, -101, -138, -153 and -180.

Both dioxins and PCBs are very stable against chemical and microbiological degradation and therefore persistent in the environment. Due to their lipophilic properties, they accumulate in the food chain and are stored in fatty tissues. Investigations of the different pathways have indicated that dietary intake represents the main route of human exposure to dioxins and PCBs, with the exception of specific cases of accidental or occupational exposure.

The toxic responses to dioxins and DL-PCBs include dermal toxicity, immunotoxicity, carcinogenicity, reproductive and developmental toxicity. Especially, 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TCDD) was evaluated as carcinogenic to humans (group 1 carcinogen) by the International Agency for Research on Cancer (IARC) in 1997. Toxicity is mainly mediated through binding to the aryl hydrocarbon (Ah) receptor, thereby inducing protein synthesis. From all the theoretically possible congeners, only those substituted in each of the 2-, 3-, 7- and 8-positions of the two aromatic rings are of toxicological concern, which corresponds to 17 congeners. The 12 DL-PCBs, which are also structurally able to bind to the Ah receptor, show similar toxicological properties. For risk assessment purposes, toxicity equivalency (TEQ) was developed to describe the cumulative toxicity of complex mixtures of these compounds. By definition, the most toxic congener, 2,3,7,8-TCDD, is assigned a value of 1. The toxicity equivalency factors (TEFs) for the other toxic dioxins and DL-PCBs are between 0 and 1, indicating the magnitude of their toxicity compared to the 2,3,7,8-TCDD. The TEF values were first proposed by the World Health Organization (WHO) in 1997 and updated in 2005 (van den Berg *et al*. 1998, van den Berg *et al*. 2006), termed WHO-TEFs (Table 1). In 2001, the Scientific Committee on Food (SCF) established a group tolerable weekly intake (TWI) of 14 pg TEQ/kg body weight (b.w.) for 2,3,7,8-TCDD, all 2,3,7,8-substituted PCDDs and PCDFs and the dioxin-like PCBs. This assessment was based on the most sensitive adverse effects of

2,3,7,8-TCDD that were observed in rodent studies, namely developmental effects in rat male offspring (SCF, 2001). Recently, the Environmental Protection Agency (EPA) of the United States reanalysed the key issues related to the toxicity of dioxins and proposed a reference dose for chronic oral exposure of 7×10^{-10} mg/kg b.w. per day, which is equivalent to 4.9 pg/kg b.w. per week (EPA, 2012). This reference value is based on a decreased sperm count and motility observed in an epidemiological cohort study of men exposed as boys to 2,3,7,8-TCDD (Mocarelli *et al*. 2008).

Table 1: Toxicity equivalency factors (TEFs) proposed by WHO

	WHO-TEF$_{98}$	**WHO-TEF$_{05}$**		**WHO-TEF$_{98}$**	**WHO-TEF$_{05}$**
PCDDs			**Non-*ortho* PCBs**		
2,3,7,8-TCDD	1	1	PCB-77	0.0001	0.0001
1,2,3,7,8-PeCDD	1	1	PCB-81	0.0001	**0.0003**
1,2,3,4,7,8-HxCDD	0.1	0.1	PCB-126	0.1	0.1
1,2,3,6,7,8-HxCDD	0.1	0.1	PCB-169	0.01	**0.03**
1,2,3,7,8,9-HxCDD	0.1	0.1			
1,2,3,4,6,7,8-HpCDD	0.01	0.01			
OCDD	0.0001	**0.0003**			
PCDFs			**Mono-*ortho* PCBs**		
2,3,7,8-TCDF	0.1	0.1	PCB-105	0.0001	**0.00003**
1,2,3,7,8-PeCDF	0.05	**0.03**	PCB-114	0.0005	**0.00003**
2,3,4,7,8-PeCDF	0.5	**0.3**	PCB-118	0.0001	**0.00003**
1,2,3,4,7,8-HxCDF	0.1	0.1	PCB-123	0.0001	**0.00003**
1,2,3,6,7,8-HxCDF	0.1	0.1	PCB-156	0.0005	**0.00003**
1,2,3,7,8,9-HxCDF	0.1	0.1	PCB-157	0.0005	**0.00003**
2,3,4,6,7,8-HxCDF	0.1	0.1	PCB-167	0.00001	**0.00003**
1,2,3,4,6,7,8-HpCDF	0.01	0.01	PCB-189	0.0001	**0.00003**
1,2,3,4,7,8,9-HpCDF	0.01	0.01			
OCDF	0.0001	**0.0003**			

The NDL-PCBs elicit different types of responses than the dioxins and DL-PCBs, including neurological, neuroendocrine, endocrine, immunological and carcinogenic effects. These effects occur via multiple toxicity pathways, but do not involve binding to the Ah receptor. A risk assessment related to the presence of NDL-PCBs in feed and food was performed by the EFSA Panel on Contaminants in the Food Chain (CONTAM Panel) in 2005 (EFSA, 2005). It concluded that no health based guidance value for humans could be established for NDL-PCBs because simultaneous exposure to NDL-PCBs and dioxin-like compounds hampers the interpretation of the results of the toxicological and epidemiological studies, and the database on effects of individual NDL-PCB congeners was rather limited. However, there were indications that subtle developmental effects caused by NDL-PCBs, DL-PCBs or dioxins, alone or in combination, may occur at maternal body burdens that are only slightly higher than those expected from the average daily intake in European countries. Because some individuals and some European (sub)-populations may be exposed to considerably high average intakes, a continued effort to lower the levels of NDL-PCBs in food was warranted.

A community strategy for dioxins and PCBs was adopted by the Commission on 24 October 2001, addressing measures to limit or to eliminate their emission into the environment through source-directed measures and addressing the way to actively decrease the presence of dioxins and PCBs in food and feed. Maximum levels (ML) for the sum of dioxins, the sum of dioxins and DL-PCBs and the sum of 6 NDL-PCB indicators in food and feed are laid down in Commission Regulation (EC) No

1881/2006[5] setting maximum levels (MLs) for certain contaminants in foodstuffs, as amended by the Commission Regulation (EU) No 1259/2011[6], and in the Directive 2002/32/EC[7] on undesirable substances in animal feed, as amended by Commission Regulation (EU) No 277/2012[8]. The MLs are expressed as TEQ_{WHO05} for dioxins and DL-PCBs and on the direct sum of the 6 NDL-PCB indicators.

In addition to maximum levels, the European Commission has set action levels (AL) for dioxins and DL-PCBs as an early warning tool, recently updated by Commission Recommendation 2011/516/EC[9] on the reduction of the presence of dioxins, furans and PCBs in feed and food, and Commission Regulation (EU) No 277/2012. Since dioxins and DL-PCBs originate from different sources, separate action levels are set. In cases where levels of dioxins and/or DL-PCBs in excess of the action levels are found, it is recommended that Member States, in co-operation with operators, initiate investigation to identify the source of contamination, take measures to reduce or eliminate the source of contamination and check for the presence of NDL-PCBs. The ALs are expressed as TEQ_{WHO05}.

Maximum and action levels are calculated on the assumption that all values of the different congeners below the limit of quantification (LOQ) are equal to the LOQ, which corresponds to an upper bound concentration (UB). Levels for foodstuffs of terrestrial animal origin and marine oils are given on a fat (lipid) weight basis (lw). For the products of aquatic origin, excepted marine oil, and products of plant origin, they are expressed on a whole weight basis (ww), whereas for feed they are expressed on 88 % dry weight basis (dw). For foods containing less than 2 % fat, the maximum level is expressed on a product basis, defined as the maximum level expressed on fat for that food multiplied by 0.02. The action levels are not applicable for foodstuffs containing less than 2 % fat.

Results from national monitoring programs on the presence of dioxins and PCBs in food and feed have been reported on a regular basis to the Commission. In 2010, following a request of the Commission, EFSA produced a first compilation of the results of the monitoring of dioxins and PCBs in food and feed, which resulted in two reports (EFSA, 2010b,c). Levels of dioxins and DL-PCBs, and NDL-PCBs from respectively 7,270 and 12,563 samples collected between 1995 and 2008 from 21 EU Member States, Iceland and Norway were compiled. Highest levels of dioxins and DL-PCBs were observed in liver products from both aquatic and terrestrial animals (on average, respectively 32.6 pg TEQ_{WHO98}/g_{ww} and 5.7 pg TEQ_{WHO98}/g_{lw}), on eels muscle (on average 6.7 pg TEQ_{WHO98}/g_{ww}) and in fish oil for animal feeding (on average 10.0 pg TEQ_{WHO98}/g_{dw}). The percentage of results exceeding the maximum level for dioxins and DL-PCBs was on average 8 % with a further 4 % exceeding the action levels. The highest levels of NDL-PCBs were observed in products derived from aquatic animals (from on average 23.3 $\mu g/kg_{ww}$ for muscle from fish other than eels to 223 $\mu g/kg_{ww}$ for eel muscle), followed by products derived from terrestrial animals (from on average 1.04 $\mu g/kg_{lw}$ for pig fat to 16.7 $\mu g/kg_{lw}$ for egg products) and feed for fur animals, pets and fish (11.1 $\mu g/kg_{dw}$). A detailed analysis of the contamination profiles revealed that PCDD/Fs represented between 30 and 74 % of the total TEQ depending on the food or feed group, while mono-*ortho* PCBs represented between 15 % and 45 % of the DL-PCBs. For NDL-PCBs, PCB-153 and PCB-138 together consistently comprised at least 50 % of the overall sum of the six indicator PCBs in each food group. Both reports recommended to pursue testing dioxins and PCBs in food and feed on a random basis and to improve the reporting of the sampling strategy at the sample level.

In 2010, EFSA received from the European Commission the mandate to collect and analyse on a continuous basis all available data on dioxins and PCBs in food and feed. The mandate includes the publication, every 2 years, of a report analysing these data.

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[5] Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs. OJ L 364, 20.12.2006, p. 5-24.

[6] Commission Regulation (EU) No 1259/2011 of 2 December 2011 amending Regulation (EC) No 1881/2006 as regards maximum levels for dioxins, dioxin-like PCBs and non dioxin-like PCBs in foodstuffs. OJ L 320, 3.12.2011, p. 18-23.

[7] Commission Directive 2002/32/EC of 7 May 2002 of the European Parliament and of the Council on undesirable substances in animal feed. OJ L 140, 30.5.2002, p.10.

[8] Commission Regulation (EU) No 277/2012 of 28 March 2012 amending Annexes I and II to Directive 2002/32/EC of the European Parliament and of the Council on undesirable substances in animal feed as regards maximum levels and action thresholds for dioxins and polychlorinated biphenyls. OJ L 91, 29.3.2012, p.1-7.

[9] Commission Recommendation 2011/515/EU of 23 August 2011 on the reduction of the presence of dioxins, furans and PCBs in feed and food. OJ L218, 24.8.2011, p.23-25.

2. Objectives

In the framework of the continued data collection and analysis mandate, the present report updates the previous data analysis on dioxins and PCBs in food and feed:

1. Extraction from the Member States submissions of the original information for dioxins and PCBs,
2. Collation and checking of the accuracy and details of the submitted information,
3. Evaluation of contamination levels for food and feed categories as nominated in the EU legislation for dioxins and PCBs,
4. Assessment of the dietary exposure of the European population to dioxins and PCBs.

A special emphasis is given in the evaluation of time trends in the food contamination levels and on the exposure of the European population.

3. Material and methods

3.1. Sampling, analytical and reporting procedures

The procedures and requirements for sample collection, preparation and analyses to monitor the levels of dioxins and PCBs in foodstuffs are detailed in the Commission Regulation (EC) No 1883/2006[10], which has been replaced in the beginning of 2012 by the Commission Regulation (EU) No 252/2012[11]. Some measures to monitor PCBs in live animals and animal products are also described in Council Directive 96/23/EC[12]. The methods of sampling and analysis for the official control of feed are laid down in Commission Regulation (EC) No 152/2009[13], amended in the beginning of 2012 by the Commission Regulation (EU) No 278/2012 of 28 March 2012[14]. In accordance with the provisions of Regulation (EC) No 882/2004[15] of the European Parliament and of the Council, laboratories shall be accredited by a recognised body operating in accordance with ISO Guide 58 to ensure that they are applying analytical quality assurance. Laboratories shall be accredited following the EN ISO/IEC 17025 standard.

Since January 2010, data submitted to EFSA should be compliant with the Standard Sample Description (SSD) agreed between EFSA and the EU Member States (EFSA, 2010a). The SSD requires the nature of the food samples to be defined according to the FoodEx catalogue. SSD allows to characterise precisely the sample and the context under which it was collected, as well as to report individual results both qualitatively (quantified or not) and quantitatively, accompanied with information on its uncertainty and the analytical method used.

3.2. Data management and validation

It should be noted that this report includes data from 1995 to 2010, including data that were generated before the aforementioned requirements being set, and data that were generated in other frameworks than official controls. A detailed data quality control was consequently performed in order to ensure the overall comparability of the data.

[10] Commission Regulation (EC) No 1883/2006 of 19 December 2006 laying down methods of sampling and analysis for the official control of levels of dioxins and dioxin-like PCBs in certain foodstuffs. OJ L364, 20.12.2006, p.32-43.
[11] Commission Regulation (EU) No 252/2012 of 21 March 2012 laying down methods of sampling and analysis for the official control of levels of dioxins, dioxin-like PCBs and non-dioxin-like PCBs in certain foodstuffs and repealing Regulation (EC) No 1883/2006. OJ L84, 23.3.2012, p. 1-22.
[12] Council Directive 96/23/EC of 29 April 1996 on measures to monitor certain substances and residues thereof in live animals and animal products and repealing Directive 85/358/EEC and 86/469/EEC and Decisions 89/187/EEC and 91/664/EEC. OJ L 125, 23.5.93.
[13] Commission Regulation (EC) No 152/2009 of 27 January 2009 laying down the methods of sampling and analysis for the official control of feed. OJ L 54, 26.2.2009, p. 1-130.
[14] Commission Regulation (EU) No 278/2012 of 28 March 2012 amending Regulation (EC) No 152/2009 as regards the determination of the levels of dioxins and polychlorinated biphenyls. OJ L 91, 29.3.2012, p. 8-22.
[15] Regulation (EC) No 882/2004 of the European Parliament and of the Council of 29 April 2004 on official controls performed to ensure the verification of compliance with feed and food law, animal health and animal welfare rules. OJ L 165, 30.4.2004, p.6-135.

3.2.1. Automatic control process

Since 2011, data submitted directly to EFSA undergo an automatic control process, consisting in a list of business rules implemented automatically when data are uploaded into the main data repository for upcoming data (Data Collection Framework). In brief, incoming data must fulfil specific requirements and reflect the SSD format. The system alerts when requirements are not fulfilled and a correction can be performed. Moreover, an advanced standardisation procedure is performed monthly in incoming data, addressing issues not covered by the SSD and the Guidance on Specific Requirements by Chemical Contaminants (EFSA, 2012). The process is completed with a feedback request by EFSA to data providers, resulting in an approval of data as stored in the EFSA database or in a request of revision for specific issues by data providers.

3.2.2. Consistency of the information

The data used in this report were submitted through different data calls, the earlier ones organised by the Commission, the new ones directly managed by EFSA. Data corresponding to the same [country x year x food] combinations coming from different submissions were checked for potential duplicates. When duplicates were identified, only the most recent submission was kept for further analysis.

The consistency of the information related to the food description, the fat and moisture content, the unit of expression of the result, the result and the limit of detection and/or quantification was checked at the sample level. The presence of duplicated results for the same congener was also verified. Accordingly, correction was brought to the data set. If needed, the data provider was asked for clarifications.

3.2.3. Food classification

In view of the exposure assessment, all data were reclassified according to the FoodEx1 system for food and to the new classification defined for feed by the Commission Regulation (EU) No 575/2011 on the Catalogue of feed materials[16]. In order to report the contamination levels, the data were also expressed according to the food and feed groups defined in the Commission Regulation (EC) No 1881/2006, the Commission Recommendation 2011/516/EU as well as in the Directive 2002/32/EC. The legislation distinguishes wild caught and farmed fish. When the information was missing, the sample was considered to correspond to a wild caught fish. The legislation also distinguishes freshwater fish from the other fish and fisheries products. When the information on the specie was missing or not detailed enough, the sample was considered not to correspond to freshwater fish.

3.2.4. Information on unit and unit of expression of the result

The availability of the unit of measure and its unit of expression is a prerequisite for data analysis.

The former Commission Recommendation 2006/794/EC suggested to adopt picogram/gram (pg/g) when reporting results for dioxins and DL-PCBs, and nanogram/gram (ng/g) or microgram/kilogram (µg/kg) for NDL-PCBs[17]. When the information was missing, which sometimes happened in the old datasets, it was assumed that the results were expressed as required by the legislation. For evaluating the contamination levels, all results were converted into the unit recommended by the legislation.

The legislation also prescribes how the results should be expressed for the respective food and feed groups, either on fat, 12% standardised moisture content or whole weight basis. When not reported, the expression of results was assumed to be compliant with the legislation. On the other hand, when the expression of results was not in agreement with legislation requirements, the concentration was converted to the right unit using the reported or approximated fat content and/or moisture content.

[16] Commission Regulation (EU) No 575/2011 of 16 June 2011 on the Catalogue of feed materials. OJ L159, 17.6.2011, p. 25-65.
[17] The Commission Regulations (EU) No 252/2012 and 278/2012 now require the results to be expressed in the same units as the maximum levels laid down in Commission Regulation (EC) No 1881/2006 and in the Directive 2002/32/EC.

3.2.5. Missing information on the fat and/or moisture content

When the information required to convert the result into the right unit was missing, then the random hot-deck imputation technique (Andridge *et al*., 2010) was applied in order to approximate the missing value. This technique consists of replacing the missing value with an observed one, which is randomly drawn from values corresponding to samples sharing "similar" characteristics. In the case of fat and moisture content, the "similar" characteristic was defined by the kind of food or food group, according to the different levels of hierarchy of the FoodEx1 catalogue. For example, in case of a missing fat content value for a sample of "mutton/lamb meat", then a fat content was randomly drawn among the fat contents observed in other samples of "mutton/lamb meat". In absence of data on the fat content of "mutton/lamb meat" then, a value was drawn among the fat contents observed in "livestock meat", and in case of failure, among the fat contents observed in "meat and meat products". Such approach has the main advantage that it allows to analyse a full and complete dataset. While the hot deck estimate of the mean equals to the mean of the observations, the estimated variance is considered to be less biased than when the missing values are replaced by a median or an average estimated from the observed data. The process was validated by checking that the mean and variance of contamination estimated for each food were not altered by the results for which the fat and/or moisture content were approximated.

3.2.6. Missing values for individual congeners

Samples for which results were expressed only on the sum of the six NDL-PCB indicators or on the total TEQ for dioxins and DL-PCBs were excluded from the data set. This was motivated by a possible heterogeneity in the way the levels of individual congeners had been summed and is in accordance with the requirements the Commission Regulations (EU) No 252/2012 and 278/2012.

According to the methodology adopted in the previous reports (EFSA, 2010b,c):

- Samples for which at least one of the six NDL-PCB indicators was missing, were not taken into account for evaluating the contamination of NDL-PCBs,
- Samples for which at least one of the following congeners – 2,3,4,7,8-PeCDF, 1,2,3,7,8-PeCDD, 2,3,7,8-TCDD, 2,3,7,8-TCDF, PCB-126 – was missing, were not taken into account for evaluating the contamination of dioxins and DL-PCBs.

Missing values for the other dioxins and DL-PCBs congeners than the five aforementioned ones were imputed using the hot-deck imputation technique previously described. All missing values in one sample were replaced by the corresponding values of the selected sample, which was drawn in the set of samples, with results available for all the congeners which were not identified as statistical outliers, and which shared the following characteristics:

- same country, same food, same qualitative results for the five congeners (2,3,4,7,8-PeCDF, 1,2,3,7,8-PeCDD, 2,3,7,8-TCDD, 2,3,7,8-TCDF, PCB-126),
- if no sample could be found, then the characteristics were restricted to the same country and same food,
- if no sample could be found, then the characteristics were restricted to the same food.

The process was validated by checking that the mean and variance of the level of contamination estimated for each food were not altered by the results for which levels for some individual congeners were approximated.

3.2.7. Minimal analytical performance requirements

The remaining samples were checked for analytical performance criteria. For NDL-PCBs, these were previously set with the support of the EU Reference Laboratory for Dioxins and PCBs in Feed and Food, Freiburg, Germany and the European Commission (EFSA, 2010b). For dioxins and DL-PCBs, these were derived from the Commission Regulation (EC) No 1883/2006 (EFSA, 2010c).

In a first step, depending on the food and feed groups, samples with a LOQ higher than 0.2, 1 or 2 µg/kg at the congener level for the NDL-PCBs, or with a LOQ higher than one fifth of the ML for the sum of dioxins and DL-PCBs were excluded. Existing MLs before the amendments brought by the Commission Regulations (EU) No 1259/2011 and 277/2012 were taken into account. These were expressed in TEQ_{WHO98} (Table 2).

In a second step, for quantified results only, lower (LB) and upper (UB) bound estimates were compared. LB and UB values were determined by setting congener-specific analytical results reported to be below the LOQ to zero and LOQ respectively. Samples were excluded when the percentage difference between the upper and lower bound estimates of the sum of all the congeners, taking the upper bound as a reference, was greater than a pre-defined threshold value. For NDL-PCB, the threshold value was set for each food and feed group (Table 2). For dioxins and DL-PCBs, whatever the food or feed group, the threshold values were set to 60 % for levels in the range of 0.2 to 0.4 pg TEQ_{WHO98}/g, to 50 % in the range of 0.4 to 0.8 pg TEQ_{WHO98}/g, and to 30 % for levels greater than 0.8 pg TEQ_{WHO98}/g.

Table 2: Analytical performance criteria applied to the data.

Food / Feed group	Cut-off LOQs		Threshold values defined for NDL-PCB		
	NDL PCBs[(a)]	Dioxins and DL-PCBs[(b)]	Range 1[(c)]	Range 2[(c)]	Range 3[(c)]
Fat of pig	2	0.3	2-10 (40)	> 10 (20)	-
Fat of poultry	2	0.8	2-10 (40)	10-25 (30)	> 25 (20)
Fat ruminants	2	0.9	2-10 (40)	10-25 (30)	> 25 (20)
Fish liver and derived products	1	5	> 75 (20)	-	-
Fruits, vegetables and cereals	1	-	> 1 (20)	-	-
Hen eggs and egg products	2	1.2	2-10 (40)	10-40 (30)	> 40 (20)
Infant and baby foods	0.2	-	> 1 (20)	-	-
Liver terrestrial animals	2	2.4	2-10 (40)	10-40 (30)	> 40 (20)
Marine oil	2	2	2-10 (40)	10-180 (30)	> 180 (20)
Meat bovine animals and sheep	2	0.9	2-10 (40)	10-25 (30)	> 25 (20)
Meat pigs	2	0.3	2-10 (40)	> 10 (20)	-
Meat poultry	2	0.8	2-10 (40)	10-25 (30)	> 25 (20)
Mixed animal fats	2	-	2-10 (40)	> 10 (20)	-
Muscle meat eel	1	2.4	> 300 (20)	-	-
Muscle meat fish	1	1.6	> 75 (20)	-	-
Muscle meat fish	1	1.6	> 75 (20)	-	-
Other food products	2	-	> 30 (20)	-	-
Raw milk and dairy products	2	1.2	2-10 (40)	10-20 (30)	> 20 (20)
Vegetable oils and fats	2	0.3	2-10 (40)	> 10 (20)	-
Additives binders and anti-caking agents	1	0.3	1-5 (40)	5-8 (30)	> 8 (20)
Additives compounds of trace elements	1	0.3	1-5 (40)	5-8 (30)	> 8 (20)
Animal fat	1	0.6	1-5 (40)	5-8 (30)	> 8 (20)
Compound feed, excl. fur animals, pets, fish	1	0.3	1-5 (40)	5-8 (30)	> 8 (20)
Feed for fur animals, pets and fish	2	0.45	2-10 (40)	10-30 (30)	> 30 (20)
Feed materials of mineral origin	1	0.3	1-5 (40)	5-8 (30)	> 8 (20)
Feed materials of plant origin, oils excluded	1	0.25	1-5 (40)	5-8 (30)	> 8 (20)
Feed not specified	1	-	1-5 (40)	5-8 (30)	> 8 (20)
Fish oil	2	4.8	2-10 (40)	10-100 (30)	> 100 (20)
Fish, other aquatic animals, their product	2	0.9	2-10 (40)	10-100 (30)	> 100 (20)
Other feed additives	1	-	1-5 (40)	5-8 (30)	> 8 (20)
Other land animal products	1	0.25	1-5 (40)	5-8 (30)	> 8 (20)
Premixtures	1	0.3	1-5 (40)	5-8 (30)	> 8 (20)
Vegetable oils and their by-products	1	0.3	1-5 (40)	5-8 (30)	> 8 (20)

(a): LOQ expressed in µg/kg for each individual NDL-PCB. (b): LOQ expressed in pg TEQ_{WHO98}/g for the sum of dioxins and DL-PCBs. (c): Range: concentration range expressed in µg/kg (threshold value expressed in % of difference between UB and LB).

3.2.8. Overall validation

As a final step, an outlier analysis was performed according to the Tukey's method (Tukey, 1977), which identifies as outlier a value greater than the 75th percentile plus 1.5 times the interquartile distance, or less than the 25th percentile minus 1.5 times the inter-quartile distance. The analysis was done on the sum of the six NDL-PCB indicators and the sum of dioxins and DL-PCBs expressed in TEQ_{WHO05}.

This procedure allowed identification of:

- samples for which an error in reporting the unit and/or unit of expression of the analytical result or the fat content was suspected. If needed, it was asked to the data provider to check the data. The data set was corrected accordingly,
- samples for which missing information (fat or moisture content, level of one or several congener) had been assumed during the previous steps of the data quality control. In such cases, the missing information was considered to be crucial for the interpretation of the result. Unless clarification could be given by the data provider, these samples were excluded from the dataset.
- "suspect samples" which have been collected only to confirm or reject a suspicion of non-conformity. Such samples were included in the evaluation of the food and feed contamination, but were not taken into account in the exposure assessment, as they are clearly not representative of the background contamination of foods available for consumption on the European market.

3.2.9. Conclusion of the data quality control

The number of individual sample results submitted (duplicates excluded) is 30,829 for dioxins and DL-PCBs and 34,191 for NDL-PCBs.

The cleaning process led to the exclusion of almost half of the samples for dioxins and DL-PCBs, mostly explained by the high number of samples in which some DL-PCBs – mainly PCB-118 but also PCB-105 and PCB-158 – had been analysed with other PCBs but not with dioxins.

As a consequence, respectively 16,238 and 32,984 samples were checked for compliance to analytical performance criteria defined for dioxins and DL-PCBs, and NDL-PCBs. This step led to the exclusion of around 40 % of the samples of NDL-PCBs. It was noticed that the majority of these rejected samples were analysed in the framework of Directive 96/23/EC and/or Regulation (EC) n°396/2005[18], probably with other organochlorine compounds corresponding to pesticide residues. In these frameworks, as the maximum residue limits (MRLs) for organochlorine pesticide residues are mostly in the range of 10-50 µg/kg (and up to 1 mg/kg), the analytical method may not be sensitive enough to detect levels in the range of 0.2-2 µg/kg, corresponding to the cut-offs applied in this study. Moreover, different reporting rules apply, especially concerning the unit of expression of the result. Indeed, for meat and egg products, the Regulation (EC) n°396/2005 requires the result to expressed on a fat weight basis if the sample contains more than 10 % fat, on a whole weight basis in other situations. This sometimes generated some exclusions after the conversion into the expected unit of expression (i.e. fat weight basis for product from terrestrial animal origin whatever the fat content was).

The final dataset, after the exclusion of samples for which the missing information couldn't be reasonably assumed, contained 13,797 samples with results for dioxins and DL-PCBs, and 19,181 samples with results for NDL-PCBs. This corresponds to respectively almost two and one and half times more data than what was analysed in the previous EFSA reports.

[18] Regulation (EC) No 396/2005 of the European parliament and of the council of 23 February 2005 on maximum residue levels of pesticides in or on food and feed of plant and animal origin and amending Council Directive 91/414/EEC.

3.3. Statistical analysis for the evaluation of the contamination levels

3.3.1. Descriptive statistics

Frequency tables were produced to describe the distribution of dioxins and PCBs by year of collection, country of testing and food and feed groups.

In order to describe the background contamination levels of food and feed available on the EU market, all data from different countries were merged by food and feed groups, irrespective of the sampling design. Two estimates were produced depending on the assumption made on the results below the LOD/LOQ: the lower bound estimate, replacing all the result reported as below the LOD/LOQ by 0, and the upper bound estimate, replacing all the results reported as below the LOD/LOQ to their respective LOD/LOQ. The true distribution will fall between these two extreme estimates. The direct sum concentration was calculated for the six NDL-PCB indicators, while the TEQ_{WHO05} was used for the dioxins and DL-PCBs.

Mean and standard deviation and different percentiles (50^{th}, 95^{th} and 99^{th}) were computed for the sum of the six NDL-PCBs, the TEQ_{WHO05} dioxins and DL-PCBs as well as for each individual NDL-PCB indicator and for PCDDs, PCDFs, non-*ortho* PCBs and mono-*ortho* PCBs expressed in TEQ_{WHO05}. The contribution of the individual or group compounds to the total, defined as the ratio between the mean individual level and the mean of the total expressed in percentage, was determined for all and for the 5 % most contaminated samples. Finally, levels of PCDD/Fs, DL-PCBs, sum of dioxins and DL-PCBs, and of the 6 NDL-PCB indicators were compared to their corresponding AL/ML in order to estimate the percentage of levels above the limit.

All analyses were run using the SAS Statistical Software (SAS enterprise guide 4.2, 2006-2008).

3.3.2. Time trend analysis

The time trend was investigated by detecting trends in the annual values of dioxins and PCBs in food and feed at the European level. The MS Excel® application "MAKESENS", originally developed by the Finnish Meteorological Institute for detecting and estimating trends in atmospheric and precipitation concentrations (Salmi *et al*., 2002), was used. This application performs two types of statistical analysis. First, the presence of a monotonic increasing or decreasing trend is tested with the nonparametric Mann-Kendall test. Secondly, the slope of a linear trend is estimated with non parametric Sen's method. It was assumed the trend to be monotonic, so no seasonal or other cycle to be present in the data. The information should be available for a minimum of 4 years (which can be non consecutive) in order for the tests to be applied and 10 years for confidence intervals around the slope estimate to be characterised. These methods offer many advantages. Missing values are allowed and the data need not conform to any particular distribution. Besides, the Sen's method is not greatly affected by single data errors or outliers.

The analysis was restricted to the best documented food/feed groups, in relation to the number of years represented (more than 10 years), the number of detailed data per year (more than 30 data for most of the years of the time series) and the number of countries providing data (at least 5 countries for most of the years of the time series).

The median contamination of the selected food/feed groups was estimated for each year of sampling and used as input for the time trend analysis. All available data were taken into account, without any adjustment to correct the possible heterogeneity between the years or groups of years, in terms of detailed kind of food/feed represented, countries of origin and targeting strategies. It was considered that any trend throughout the years observed at this level of aggregation of the data would be explained by background phenomena, such as the outcome of the emission control measures of dioxins at the European level, rather than by variations in the monitoring strategy.

3.3.3. Special focus

3.3.3.1. Contribution of other NDL-PCBs than the six indicators

In some samples, results were available for other NDL-PCBs than the six indicators. The mean contamination was estimated for each of these individual NDL-PCB and compared to the sum of all the measured NDL-PCBs levels.

3.3.3.2. Relationship between NDL-PCBs and DL-PCBs

In some samples, results were available for both NDL-PCBs and DL-PCBs. The correlation between the total levels of the six NDL-PCB indicators and DL-PCBs, expressed respectively in µg/kg and in pg $TEQ_{WHO2005}$/g, was assessed for each food/feed groups through a regression analysis applied on the upper bound estimates. It was performed through the procedure REG in the SAS software. For some food/feed groups, a sensitivity analysis to outliers was also conducted.

3.3.3.3. Special food groups

Mean and standard deviations and different percentiles (50^{th}, 95^{th} and 99^{th}) were computed at the lower and upper bound concentrations for the six NDL-PCB indicators and the sum of dioxins and DL-PCBs for the following food groups:

- Meat from bovine animals and sheep: bovine/sheep,
- Raw milk and dairy products: milk from farm/bulk/retail/not specified, butter, cheese, other milk products,
- Hen eggs and egg products: battery/free range/outside/organic/not specified,
- Muscle meat of fish and fish products excluding eels: wild caught char, wild caught herring, wild caught salmon and trout, wild caught freshwater fish, other wild caught fish, farmed salmon and trout, other farmed fish, seafood, and fish products.

When at least 30 samples were available, a comparison in the distribution of contaminations was then conducted between:

- Eggs from battery/free range/outside/organic,
- Milk from farm/bulk/retail,
- Meat from bovine animals/sheep animals,
- Farmed salmon and trout/wild caught salmon and trout,
- Salmon and trout collected in countries near the Baltic sea/salmon and trout collected in other countries,
- Herring collected in countries near the Baltic sea/herring collected in other countries.

After having checked the log normality of the distributions, their log-transformations were compared through the parametric T-test with the Bonferroni adjustment in case of more than two modalities. The procedures Univariate, T-Test and GLM with Bonferroni option of the SAS software were used for this analysis.

3.4. Exposure assessment

The exposure of the European (sub)populations to the sum of dioxins and DL-PCBs was estimated and compared to the current European TWI of 14 pg TEQ/kg b.w. (SCF, 2001). The exposure to NDL-PCBs was also assessed. Three time periods were considered: 2002-2004, 2005-2007 and 2008-2010, the last period being taken as a reference.

3.4.1. Contamination data

Contamination data correspond to those previously described, without the statistical outliers associated with "suspect" samples, which were collected only to confirm or reject a suspicion of non-conformity (respectively 20 and 2 samples for dioxins and DL-PCBs, and NDL-PCBs).

3.4.1.1. Level of aggregation of the data

The different food commodities were described according to the FoodEx1 catalogue, which allows characterisation of up to 1,908 foods and food groups at four different levels of hierarchy. While working at the finest level of the food description has the advantage of an increased precision in the exposure estimates, those estimates may, on the other hand, lack robustness when too few samples are available to describe the contamination level of the food. A specific analysis was conducted to define the appropriate level of aggregation of the data.

At the finest level, the food was retained if more than 30 samples were available. When less than 30 samples were available, the food was retained only if either the variability was low enough[19] for the average contamination level to be estimated with few samples only or if the average contamination level was different from the one observed in other foods belonging to the same group. Some assumptions were also made for a few foods, attributing the contamination levels of similar food/food groups with close patterns of contamination. For example, "Goose fat" and "Duck fat" were assumed to be contaminated similarly to "Chicken fat". For other cases, food was handled at a higher level of hierarchy of the FoodEx1 catalogue.

This process was iterated through the different hierarchical levels of the FoodEx1 catalogue, in order to define for each food consumed a corresponding contamination food/food groups.

3.4.1.2. Estimation of the contamination

According to the WHO guidelines on the censorship treatment (GEMS/Food-EURO, 1995), when more than 40 % of the results were quantified at the food and food group levels, the average contamination level was estimated considering the non detected/quantified results at half of their respective LOD/LOQ (middle bound approach). In the other cases, the average contamination level was estimated at the lower and upper bounds, as previously described.

The contamination levels corresponding to vegetable oils and fats and products from terrestrial animals were expressed on a fat content basis whereas the contamination levels of other foods were expressed on a whole weight basis.

Estimates were produced for each period of interest, using the same level of aggregation of data as the one defined for the period of reference (2008 – 2010), in order for the results to be comparable between the different periods of time.

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[19] As a first approach, the minimum number of samples "required" to estimate the mean contamination level with an error of 40% was first calculated according to the following formula (Bouyer, 2000).

$$n = \frac{z^2_{(\alpha)} * s^2}{i^2}$$

with z(α): the z-score corresponding to the acceptable risk (for α = 0.05, z(α) = 1.96, s^2: estimation of the variance of the contamination level, i: error of the estimate, defined according to the available data.

If the number of samples available was less than 30 but higher than number "required", then the corresponding level of food was retained for the exposure assessment.

3.4.2. Consumption data

The consumption data were derived from the EFSA Comprehensive European Food Consumption Database (Comprehensive database) which was built in 2010 from existing national information on food consumption at the individual level (EFSA, 2011, Huybrechts *et al*., 2011, Merten *et al*., 2011). In view of performing a chronic exposure assessment, only individuals with at least two days of reporting were selected (Table 3). This represented 53,728 individuals from 28 surveys and 17 different European countries covering the following age-groups: infants (< 1 year old), toddlers (≥ 1 year to < 3 years old), children (≥ 3 years to < 10 years old), adolescents (≥ 10 years to < 18 years old), adults (≥ 18 years to < 65 years old), elderly (≥ 65 years to < 75 years old) and very elderly (≥ 75 years old). According to the surveys, consumption data were collected either through repeated 24h or 48h dietary recalls, or through dietary records covering 3 to 7 days.

Consumption levels of vegetable oils and fats, and products from terrestrial animals were expressed on a fat content basis. When the fat content of one detailed food was not available in a given survey, then it was replaced by a value drawn among those available in other surveys according to the different levels of hierarchy of the FoodEx1 catalogue, using the hot-deck imputation technique.

The average consumption level was estimated at the finest individual level available.

3.4.3. Exposure modelling

Chronic exposure was assessed at the individual level by multiplying the average consumption for each food with the corresponding average contamination, summing up the respective intakes throughout the diet, and finally dividing the results by the individual's body weight. The whole diet was taken into account, except for foods not covered by enough occurrence data and for which an assumption on their contamination level was not possible.

The average as well as the 95th percentile of exposure were derived for each population group (i.e. [survey x age class] combinations). For dioxins and DL-PCBs, the percentage of individuals with an exposure higher than the TWI of 14 pg TEQ/kg b.w. and its 95 % confidence intervals were characterised. Exposure estimates were produced for each period of interest.

The contribution of the food groups, corresponding to the first level of hierarchy of the FoodEx1 catalogue, to total exposure was determined for each population group. For dioxins and DL-PCBs, the detailed food and food groups contributing to more than 10 % of the TWI were identified in each population group considering on the one hand all individuals and on the other hand, the 5 % most exposed individuals only. The analysis of food contribution to the total exposure was restricted to the most recent period (2008-2010).

The exposure was modelled with the SAS software.

3.4.4. Time trend analysis

Time trends in the exposure were investigated comparing the individual exposure estimates for the different periods of interest through the T-test and the Wilcoxon test. The procedure UNIVARIATE of the SAS software was used. Population groups with less than 30 individuals were not taken into account in the statistical analysis. These comprised infants in Italy, toddlers in Spain and very elderly in Denmark.

Table 3: Dietary surveys considered for the chronic dietary exposure assessment and number of subjects in the different age classes.

Country	Dietary survey acronym	Method	Days	Year	Number of subjects with more than 2 reporting days							
					Infants	Toddlers	Other children	Adolescents	Adults	Elderly	Very elderly	Total
Belgium	Diet National 2004	24h dietary recall	2	2004	-	-	-	584	1,304	518	712	3,118
Belgium	Regional_Flanders	Dietary record	3	2003	-	36	625	-	-	-	-	661
Bulgaria	NUTRICHILD	24h dietary recall	2	2007	860	428	433	-	-	-	-	1,721
Cyprus	Childhealth	Dietary record	3	2003	-	-	-	303	-	-	-	303
Czech Republic	SISP04	24h dietary recall	2	2004	-	-	389	298	1,666	-	-	2,353
Denmark	Danish Dietary Survey	Dietary record	7	2001	-	-	490	479	2,822	309	20	4,120
Finland	DIPP	Dietary record	3	2005	-	497	933	-	-	-	-	1,430
Finland	FINDIET 2007	48h dietary recall	2	2007	-	-	-	-	1,575	463	-	2,038
Finland	STRIP	Dietary record	4	2000	-	-	250	-	-	-	-	250
France	INCA2	Dietary record	7	2006	-	-	482	973	2,276	264	84	4,079
Germany	DONALD 2006	Dietary record	3	2006	-	92	211	-	-	-	-	303
Germany	DONALD 2007	Dietary record	3	2007	-	85	226	-	-	-	-	311
Germany	DONALD 2008	Dietary record	3	2008	-	84	223	-	-	-	-	307
Germany	NVS II	24h dietary recall	2	2006	-	-	-	1,011	10,419	2,006	490	13,926
Greece	Regional Crete	Dietary record	3	2005	-	-	839	-	-	-	-	839
Hungary	National Repr Surv	Dietary record	3	2003	-	-	-	-	1,074	206	80	1,360
Ireland	NSIFCS	Dietary record	7	1998	-	-	-	-	958	-	-	958
Italy	INRAN SCAI 2005 06	Dietary record	3	2006	16	36	193	247	2,313	290	228	3,323
Latvia	EFSA TEST	24h dietary recall	2	2008	-	-	189	470	1,306	-	-	1,965
Netherlands	DNFCS 2003	Dietary record	3	2003	-	-	-	-	750	-	-	750
Netherlands	VCP kids	24h dietary recall	2	2006	-	322	957	-	-	-	-	1,279
Spain	AESAN	24h dietary recall	2	2009	-	-	-	-	410	-	-	410
Spain	AESAN FIAB	Dietary record	3	2001	-	-	-	86	981	-	-	1,067
Spain	enKid	24h dietary recall	2	2000	-	17	156	209	-	-	-	382
Spain	NUT INK05	24h dietary recall	2	2005	-	-	399	651	-	-	-	1,050
Sweden	NFA	24h dietary recall	4	2003	-	-	1,473	1,018	-	-	-	2,491
Sweden	Riksmaten 1997 98	Dietary record	7	1997	-	-	-	-	1,210	-	-	1,210
United Kingdom	NDNS	Dietary record	7	2001	-	-	-	-	1,724	-	-	1,724

4. Results and discussion

In the following sections, summary statistics are provided for each food/feed group or population group irrespective of the number of observations. It should be pointed out that in case of too few observations, the estimation of high percentiles may be biased (less than 60 observations for the 95th percentile and less than 300 observations for the 99th percentile) and must consequently be interpreted cautiously (EFSA, 2011).

4.1. Overview of the data available for analysis

The final data set obtained after the data quality control process included results from 24 EU Members States, and Iceland and Norway (Tables 4 and 5). Compared to the previous reports, three new Members States – Hungary, Latvia and Slovakia – provided data. Italy provided data on dioxins and DL-PCBs for the first time, whereas Spain and Cyprus provided data on NDL-PCBs for the first time. On the other hand, Belgium, Iceland, Ireland, Lithuania, Luxembourg and Romania have not updated their data sets since the previous reports. Only three Members States did not submit any results at all: Bulgaria, Malta and Portugal. At the end, five Member States provided together more than half of the samples for dioxins and DL-PCBs: Germany (23.8 %), United Kingdom (10.9 %), Denmark (10.2 %), Italy (9.2 %) and Norway (7.7 %). For NDL-PCBs, two Member States provided together more than half of the samples available: Germany (41.4 %) and Denmark (13.2 %).

The data collection covered results from the years 1995 to 2010, with the majority of samples between 2003 and 2010. The year of collection was missing for 46 samples for dioxins and DL-PCBs. Compared to the previous reports, the new data submitted covered mainly the years 2008 to 2010, but data sets from the years 2003 to 2007 have also been completed for some countries.

4.1.1. Overall representativeness

When gathering data from the different countries, in order to estimate the background level of contamination to dioxins and PCBs at the European level, it is assumed that data are representative at the national level, and that the data coming from several, but not all the countries, are representative of the whole European market.

Information on the sampling strategy was missing for around three quarters of samples analysed in this report. When it was reported, it appeared that overall 49 % of the samples were coming from random sampling, 50 % from selective sampling – which may be based on a risk analysis – and 1 % from suspect sampling in order to investigate a suspicion of non-conformity. This varied according to the countries. Some countries only submitted data from random sampling: Austria, Cyprus, Estonia, Greece, Latvia, Poland and Slovenia, whereas others submitted data from different kinds of sampling: Denmark, France, Germany, Hungary, the Netherlands, Slovakia and United Kingdom. The proportion of random *vs*. selective sampling also varied according to the countries, from 80/20 for France and Slovakia to 20/80 for Germany and United Kingdom, the balance being almost reached for Denmark and the Netherlands. Due to the selective strategy, data available from some countries may overestimate the background levels of contamination of dioxins and PCBs.

It is difficult to estimate the impact of the assumption that available data are representative of the European market.

4.1.2. Robustness

The food and feed groups sampled are illustrated in Tables 6 and 7. There were 10,468 food samples covering dioxins and DL-PCBs and 17,127 covering NDL-PCBs, and 3,329 feed samples covering dioxins and DL-PCBs and 2,054 covering NDL-PCBs.

Table 4: Number of samples for each sampling year by the respective country for dioxins and DL-PCBs.

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	NS[(a)]	Total
Austria	-	-	-	-	-	38	15	75	16	29	18	11	-	202
Belgium	-	-	30	55	51	71	67	108	158	-	-	-	7	547
Cyprus	-	-	-	-	-	2	-	-	14	17	21	22	-	76
Czech Republic	-	-	-	-	-	-	14	-	27	15	-	13	-	69
Denmark	-	34	40	59	15	79	13	175	194	180	257	361	-	1,407
Estonia	-	-	-	-	-	-	21	19	21	6	9	-	-	76
Finland	-	-	-	235	29	-	19	23	27	11	191	8	-	543
France	-	-	-	1	96	31	-	-	-	-	1	624	1	754
Germany	-	-	-	-	9	100	204	336	975	173	705	781	-	3,283
Greece	-	-	-	17	-	-	30	-	19	-	11	30	-	107
Hungary	-	-	-	-	-	-	-	-	-	-	69	128	-	197
Iceland	-	-	-	-	39	128	41	-	-	-	-	-	-	208
Ireland	-	-	-	-	185	91	69	120	-	10	-	-	38	513
Italy	-	-	-	-	-	-	601	321	134	219	-	-	-	1,275
Latvia	-	-	-	-	-	-	-	-	-	-	70	14	-	84
Lithuania	-	-	-	-	-	-	3	-	-	-	-	-	-	3
Luxembourg	-	-	-	12	-	-	-	-	-	-	-	-	-	12
Netherlands	-	-	40	46	-	16	7	32	82	109	17	-	-	349
Norway	2	-	8	26	93	170	105	186	237	230	-	-	-	1,057
Poland	-	-	-	-	-	-	-	30	26	83	-	107	-	246
Romania	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Slovakia	-	-	-	-	-	-	-	-	16	19	6	19	-	60
Slovenia	-	-	-	-	-	-	74	69	83	102	52	39	-	419
Spain	-	-	-	58	64	49	-	-	-	-	-	-	-	171
Sweden	-	21	39	60	38	150	103	60	71	60	32	-	-	634
United Kingdom	-	-	17	-	554	84	564	167	23	50	46	-	-	1,505
Total	2	55	174	569	1,173	1,009	1,950	1,721	2,123	1,313	1,505	2,157	46	13,797

(a): NS: not specified.

Table 5: Number of samples for each sampling year by the respective country for NDL-PCBs.

Country	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Austria	-	-	-	-	-	-	-	-	-	-	-	-	40	43	37	15	135
Belgium	-	-	-	-	-	-	-	34	27	-	-	-	147	-	-	-	208
Cyprus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23	29	52
Czech Republic	-	-	-	-	-	-	-	-	-	-	15	-	18	18	110	198	359
Denmark	-	-	-	-	-	28	40	59	15	163	178	351	329	368	320	677	2,528
Estonia	-	-	-	-	-	-	-	-	37	18	9	36	64	7	12	-	183
Finland	-	-	-	-	-	-	-	235	29	-	30	22	37	11	191	8	563
France	-	-	-	-	-	56	-	-	349	31	-	-	-	-	1	898	1,335
Germany	151	907	586	820	1532	811	605	48	61	295	41	101	136	130	900	821	7,945
Greece	-	-	-	-	-	145	116	-	-	-	-	-	56	-	49	84	450
Hungary	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iceland	-	-	-	-	-	-	-	-	45	118	41	-	-	-	-	-	204
Ireland	-	-	-	-	-	-	-	-	202	168	147	153	-	42	-	-	712
Italy	-	-	-	-	-	1	95	207	57	-	-	-	-	-	-	-	360
Latvia	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
Lithuania	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Luxembourg	-	-	-	-	-	-	-	12	-	-	-	-	-	-	-	-	12
Netherlands	-	-	-	-	28	42	44	60	-	47	105	17	125	129	17	-	614
Norway	-	-	-	-	37	-	4	36	29	94	112	175	224	74	-	-	785
Poland	-	-	-	-	-	-	-	-	-	-	-	59	47	222	-	145	473
Romania	-	-	-	-	-	-	-	-	-	-	-	92	92	-	-	-	184
Slovakia	-	-	-	-	-	-	-	-	-	-	-		19	21	18	20	78
Slovenia	-	-	-	-	-	-	-	-	-	104	22	10	3	-	-	9	148
Spain	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
Sweden	-	-	-	-	-	21	84	48	37	94	77	47	67	75	34	-	584
United Kingdom	-	-	-	-	-	-	19	-	302	17	623	183	29	48	46	-	1,267
Total	151	907	586	820	1,597	1,104	1,007	739	1,190	1,150	1,400	1,246	1,433	1,189	1,758	2,904	19,181

Table 6: Number of samples for each sampling year by food/feed for dioxins and DL-PCBs.

Food / Feed group	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	NS[(a)]	Total
Fat of pig	-	2	5	5	11	5	10	24	10	10	52	121	-	255
Fat of poultry	-	5	5	4	8	6	9	46	25	21	8	12	-	149
Fat ruminants	-	2	10	10	21	7	8	52	34	30	96	100	-	370
Fish liver and derived products	-	-	5	-	1	8	4	21	23	1	6	15	-	84
Fruits, vegetables and cereals	-	-	7	7	38	115	39	19	13	4	5	9	-	256
Hen eggs and egg products	-	5	6	17	138	43	201	145	190	45	74	249	41	1,154
Infant and baby foods	-	-	-	-	202	-	4	87	24	33	16	48	-	414
Liver terrestrial animals	-	-	-	2	9	2	25	18	25	5	7	77	-	170
Marine oil	-	-	-	-	21	5	4	30	25	-	1	5	-	91
Meat bovine animals and sheep	-	-	-	2	1	3	49	55	80	34	69	118	1	412
Meat pigs	-	-	-	-	-	3	51	23	15	13	10	54	-	169
Meat poultry	-	-	1	-	1	3	23	20	17	16	14	34	-	129
Mixed animal fats	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Muscle meat eel	-	4	37	51	5	-	26	53	45	58	62	123	-	464
Muscle meat fish (eel excluded)	-	26	38	385	404	349	421	324	386	341	378	769	-	3,821
Other food products	-	6	6	15	45	19	284	116	173	77	54	178	2	975
Raw milk and dairy products	-	5	46	49	69	28	251	265	320	85	113	190	1	1,422
Vegetable oils and fats	-	-	-	-	3	4	41	26	18	2	11	28	-	133
Additives binders and anti-caking agents	-	-	-	-	-	9	4	1	1	2	1	-	-	18
Additives compounds of trace elements	-	-	-	-	5	6	8	3	24	14	6	-	-	66
Animal fat	-	-	-	-	-	6	6	1	3	10	2	1	-	29
Compound feed, excl. Fur animals, pets and fish	-	-	-	-	81	86	178	112	170	121	157	-	-	905
Feed for fur animals, pets and fish	2	-	3	4	12	70	81	90	110	88	20	2	-	482
Feed materials of mineral origin	-	-	-	-	9	12	13	8	44	37	18	3	-	144
Feed materials of plant origin, oils excluded	-	-	-	-	37	76	113	89	232	150	264	5	-	966
Feed not specified	-	-	-	9	9	8	4	-	8	1	5	2	-	46
Fish oil	-	-	3	5	15	45	19	38	27	26	10	3	1	192
Fish, other aquatic animals, their product	-	-	2	4	18	67	40	34	39	51	31	9	-	295
Other feed additives	-	-	-	-	-	7	-	6	7	4	6	1	-	31
Other land animal products	-	-	-	-	-	1	8	2	15	7	5	-	-	38
Premixtures	-	-	-	-	10	12	17	11	10	23	-	-	-	83
Vegetable oils and their by-products	-	-	-	-	-	4	9	2	10	4	4	1	-	34

(a): NS: not specified.

Table 7: Number of samples for each sampling year by food/feed for NDL-PCBs.

Food / Feed group	≤1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Fat of pig	-	-	-	6	7	13	6	4	20	12	11	87	195	361
Fat of poultry	-	-	1	5	5	8	6	-	53	31	26	5	10	150
Fat ruminants	-	8	-	13	10	22	8	3	50	45	33	103	183	478
Fish liver and derived products	-	-	2	5	-	-	9	11	52	15	13	2	12	121
Fruits, vegetables and cereals	-	-	-	13	-	32	114	17	15	4	2	52	48	297
Hen eggs and egg products	-	6	25	29	36	224	144	78	54	68	80	81	190	1,015
Infant and baby foods	-	-	-	-	-	-	20	1	35	11	12	18	33	130
Liver terrestrial animals	-	-	-	3	4	9	2	18	10	20	9	14	36	125
Marine oil	-	-	-	-	-	12	4	4	21	16	-	-	5	62
Meat bovine animals and sheep	-	2	-	11	24	7	2	-	16	54	39	105	91	351
Meat pigs	22	7	-	11	24	1	4	5	67	22	21	21	68	273
Meat poultry	-	10	-	1	4	28	3	15	11	27	17	82	197	395
Mixed animal fats	-	-	-	-	-	-	-	-	-	1	-	-	-	1
Muscle meat eel	-	-	13	43	67	10	1	4	18	29	31	51	58	325
Muscle meat fish (eel excluded)	-	391	131	106	385	521	308	414	431	518	401	649	1,112	5,367
Other food products	-	2	126	125	22	50	129	328	106	120	49	130	366	1,553
Raw milk and dairy products	2,442	1,161	806	621	90	52	58	87	105	143	85	162	234	6,046
Vegetable oils and fats	-	10	-	-	-	5	1	8	6	4	-	12	31	77
Additives binders and anti-caking agents	-	-	-	-	-	-	4	5	-	1	2	-	-	12
Additives compounds of trace elements	-	-	-	-	-	5	7	20	5	17	15	3	-	72
Animal fat	-	-	-	-	-	-	10	5	-	4	1	-	1	21
Compound feed, excl. Fur animals, pets and fish	-	-	-	3	38	102	49	114	14	54	92	57	-	523
Feed for fur animals, pets and fish	-	-	-	4	4	3	56	40	57	60	63	6	1	294
Feed materials of mineral origin	-	-	-	-	-	11	31	26	13	11	25	7	3	127
Feed materials of plant origin, oils excluded	-	-	-	-	2	41	40	105	20	51	68	79	2	408
Feed not specified	-	-	-	-	-	-	2	5	-	8	4	1	2	22
Fish oil	-	-	-	-	-	8	39	15	34	27	28	9	3	163
Fish, other aquatic animals, their product	-	-	-	6	17	16	62	32	25	35	43	16	20	272
Other feed additives	-	-	-	-	-	-	4	-	1	6	2	1	1	15
Other land animal products	-	-	-	2	-	-	2	7	2	6	6	-	-	25
Premixtures	-	-	-	-	-	10	7	22	3	7	9	-	-	58
Vegetable oils and their by-products	-	-	-	-	-	-	18	7	2	6	2	5	2	42

The best represented food groups were “Muscle meat fish, eel excluded”, “Raw milk and dairy products” and “Hen eggs and egg products”, which altogether represented respectively 61.1 % and 72.5 % of the data available for dioxins and DL-PCBs, and NDL-PCBs. The “Other food products” group also comprised quite a lot of samples, covering different kinds of foods, as described in Table 8.

Table 8: Number of samples by detailed categories for the “Other food products”.

Other food products	Dioxins and DL-PCBs	NDL-PCBs
Other meat products		
- Livestock meat other than pig, bovine and sheep	80	35
- Game mammals and birds	147	219
- Other edible offal from farmed mammals (kidney, tongue, giblets, totters and feet)	152	282
- Transformed meat products (sausage, pâtés, etc...) and not specified meat products	130	256
Unspecified fish and seafood products	105	219
Honey and sugars	41	85
Unspecified vegetable and animal fats	159	287
Products for special nutritional use	135	92
Composite foods, snacks and foods not specified	24	37
Beverages (drinking water, tea, fruit juices, etc)	2	41
Total	**1,422**	**1,553**

The best represented feed groups were “Feed materials of plant origin, oils excluded” and “Compound feed, excluding feed for fur animals, pets and fish”, which altogether represented 56.2 % of the data available for dioxins and DL-PCBs, and 45.3 % for NDL-PCBs. Some feed groups were poorly represented, especially “Additives binders and anti-caking agents” and “Animal fat”.

The feed groups were well covered (in terms of number of samples available) from years 2003 -2004 and onwards. The food groups “Muscle meat fish, eel excluded”, “Raw milk and dairy products” “Hen eggs and eggs products” and “Other food products” were well covered from before 2003 and onwards, whereas the other food groups started to be well covered from 2006 and onwards.

Some countries submitted data only on food (Cyprus, Estonia, Finland, Poland and Slovakia for both dioxins and DL-PCBs, and NDL-PCBs; Austria, Belgium, France, Greece, Hungary, Slovenia for NDL-PCBs; Latvia for dioxins and DL-PCBs). Except for Estonia, Lithuania and Luxembourg, which provided data only for fish products, the other countries covered several food/feed groups, but never all the food/feed groups defined by the European legislation.

4.1.3. Analytical comparability

4.1.3.1. Analytical techniques

The information on the analytical methods used was provided for around half of the samples for dioxins and DL-PCBs and one quarter of the samples for NDL-PCBs. For dioxins and DL-PCBs, 17.1 % of the samples were reported to be analysed by gas chromatography in combination with mass spectrometry (GC/MS), 20.6 % by gas chromatography in combination with high-resolution mass spectrometry (GC/HRMS) and 62.2 % by high-resolution gas chromatography in combination with high-resolution mass spectrometry (HRGC/HRMS). For NDL-PCBs, 16.8 % of the samples were reported to be analysed by gas chromatography in combination with an electron capture detector (GC/ECD), 42.7 % by GC/MS, 14.8 % by GC/HRMS and 25.7 % by HRGC/HRMS. Since this information was more often missing in the oldest data sets, it is assumed that the proportion of samples analysed with the oldest techniques (GC/ECD, GC/MS) probably was underestimated.

4.1.3.2. Impact of the limits of detection/quantification

Large differences were observed in the reported limits of detection (LOD) or quantification (LOQ). As shown in Tables 9 and 10, the differences between the lowest and highest LOD/LOQ varied between 7.2×10^2 times for 2,3,4,6,7,8HxCDF and up to 6.2×10^8 times for PCB-167. This could be explained by different ranges of sensitivity of the analytical methods, and by some conversions into the right unit of expression of the results. Due to this heterogeneity, the area of censorship (i.e. of levels which couldn't be detected or quantified) sometimes overlapped quite significantly the area of quantified results. For example, of the levels of dioxins and DL-PCBs expressed on a whole weight basis, between 6.9 % (2,3,7,8-TCDF) and 52.2 % (OCDF) of the quantified values were below the median LOD/LOQ of censored results. Of the levels of NDL-PCBs expressed on a fat weight basis, between 22.5 % (PCB-153) and 94.8 % (PCB-52) of the quantified values were below the median LOD/LOQ of censored results. This implies that the upper bound estimate of half of the censored results will be higher than these quantified values. Consequently, the distribution of upper bound estimates of the concentration of dioxins and PCBs in food/feed, which will be presented later, might be overestimated.

The less commonly detected/quantified dioxins and DL-PCBs are 1,2,3,7,8,9-HxCDF, whereas the most commonly detected/quantified are PCB-77 and PCB-118. PCB-153 was the most commonly detected/quantified NDL-PCB in both feed and food, whereas PCB-28 and PCB-101 were the least commonly detected/quantified NDL-PCBs in food when respectively expressed in whole weight and fat weight basis and PCB-101 in feed.

4.2. Contamination levels

4.2.1. Contamination levels across food and feed groups

The proportion of left-censored data as well as the distribution of contamination (mean, median and high percentiles) for the sum of dioxins and DL-PCBs expressed in TEQ_{WHO05} are presented in Table 11 and on the sum of the 6 NDL-PCB indicators in Table 12. Table 13 presents the detailed results for the "Other food products". These are expressed as both lower and upper bound estimations.

Almost all the analysed food samples (98.5 %) contained at least one quantified dioxin or DL-PCB congener. Consistently with previous observations (EFSA, 2010c), the highest levels of dioxins and DL-PCBs were found for "Fish liver and derived products" and "Liver from terrestrial animals", followed by "Muscle meat from eel", with an average above 10 pg TEQ_{WHO05}/g ww for fish products and lw for liver from terrestrial animals. Six other food groups contained dioxins and DL-PCBs of more than 1 pg TEQ_{WHO05}/g_{lw} on average. They all corresponded or contained products of animal origin: "Hen eggs and eggs products", "Meat from fish other than eel", "Meat from bovine animal and sheep", "Raw milk and milk products", "Marine oil" and "Other food products". Although relative to other food groups, "Meat from poultry" contained on average low levels of dioxins and DL-PCBs (<1 TEQ_{WHO05}/g_{lw}), some high levels were found in a few samples. The "Other food products" group comprised quite heterogeneous food items. Among them, in accordance with previous observations, the foods of terrestrial animal origin – "Edible offal from farmed animals", "Game mammals and birds", "Livestock meat from other animals than pig, bovine and sheep" – contained the highest levels of dioxins and DL-PCBs. "Composite foods" and "Products of nutritional use" also contained on average more than 1 pg $TEQ_{WHO2005}/g_{ww}$ dioxins and DL-PCBs. Some supplements based on marine oils were found among the products for nutritional use, which may explain their level of contamination.

As observed in food, almost all feed samples (98.3 %) contained at least one quantified dioxin or DL-PCB congener. As previously described (EFSA, 2010c), the feed group with the highest average level of dioxins and DL-PCBs was "Fish oil", followed by "Feed for fur animals, pets and fish" and "Fish and other aquatic animals, their product". Some high levels could also be observed in a few samples of "Other feed additives" and "Vegetable oils and their by-products".

Table 9: Proportion of left-censored results and distribution of the LOQ/LOD for the dioxins and DL-PCBs.

	Expressed on whole weight (N = 5,346)(a)				Expressed on fat basis (N = 5,122) (a)				Expressed on 12% moisture (N = 3,329) (a)			
Congener	**% LC(b)**	**Range(c)**	**P50(d)**	**%Q(e)**	**% LCb)**	**Range(c)**	**P50(d)**	**%Q(e)**	**% LC(b)**	**Range(c)**	**P50(d)**	**%Q(e)**
1,2,3,4,6,7,8-HpCDF	35.6	<0.0001 -1	0.0230	45.3	30.5	0.001-7.1	0.0500	4.3	32.1	0.0005-0.5	0.0300	26.6
1,2,3,4,7,8,9-HpCDF	81.5	<0.0001 -1	0.0100	44.7	73.6	0.0005-7.1	0.0500	23.3	80.2	<0.0001 -3.6	0.0100	25.2
1,2,3,4,7,8-HxCDF	29.3	<0.0001 -0.8	0.0093	23.7	29.3	0.001-1.6	0.0450	6.5	52.7	0.0001-0.3	0.0114	16.4
1,2,3,6,7,8-HxCDF	28.9	<0.0001 -0.8	0.0090	21.3	35.2	0.0008-0.9	0.0388	5.8	56.6	<0.0001 -0.6	0.0100	11.2
1,2,3,7,8,9-HxCDF	81.7	<0.0001 -0.8	0.0077	31.7	81.3	0.0004-1.6	0.0333	18.8	84.8	0.0001-0.8	0.0100	27.3
1,2,3,7,8-PeCDF	22.7	<0.0001 -0.3	0.0090	9.9	59.2	0.0009-1	0.0340	11.5	49.5	0.0002-0.3	0.0100	8.8
2,3,4,6,7,8-HxCDF	32.2	<0.0001 -0.8	0.0100	19.2	40.4	0.0009-0.6	0.0453	8.4	58.5	<0.0001 -0.8	0.0100	10.3
2,3,4,7,8-PeCDF	13.8	<0.0001 -0.3	0.0085	10.2	20.5	0.0009-0.9	0.0300	2.0	42.1	<0.0001 -0.4	0.0100	6.7
2,3,7,8-TCDF	12.2	<0.0001 -0.7	0.0110	6.9	39.7	0.0005-1	0.0400	13.0	35.3	0.0002-0.1	0.0100	4.9
OCDF	58.3	<0.0001 -3	0.0320	52.2	50.4	0.0002-35	0.1000	16.9	43.9	0.0001-1.9	0.0496	35.4
1,2,3,4,6,7,8-HpCDD	28.3	<0.0001 -4.1	0.0400	44.3	24.3	0.0009-8.7	0.1100	7.0	23.6	0.0005-4.9	0.0400	13.4
1,2,3,6,7,8-HxCDD	24.9	<0.0001 -1	0.0100	14.6	34.6	0.0008-1.6	0.0482	5.8	59.7	<0.0001 -0.4	0.0100	9.2
1,2,3,7,8,9-HxCDD	47.0	<0.0001 -1	0.0100	28.9	54.7	0.0007-1.5	0.0500	15.4	67.8	0.0002-2.9	0.0100	16.4
1,2,3,7,8-PeCDD	27.1	<0.0001 -0.6	0.0080	9.3	48.5	0.0009-2.2	0.0500	8.5	66.2	0.0002-6	0.0100	12.1
2,3,7,8-TCDD	29.4	<0.0001 -0.7	0.0045	8.8	61.6	0.0008-1.4	0.0300	12.9	71.9	<0.0001 -0.6	0.0100	14.5
OCDD	27.5	<0.0001 -7.6	0.1000	43.7	21.9	0.0011-35	0.4300	18.7	10.7	0.0003-6.4	0.1000	6.7
1,2,3,4,7,8-HxCDD	52.0	<0.0001 -1	0.0100	28.6	54.4	0.001-1.7	0.0485	14.2	78.8	0.0002-2.4	0.0100	26.2
PCB-105	8.1	0.0006-200	10.000	17.9	13.5	0.0042-1071.4	10.000	7.3	19.6	0.0001-152.4	10.000	40.5
PCB-114	22.4	0.0002-250	1.4670	18.0	35.8	0.0037-1071.4	8.1000	45.3	43.9	<0.0001 -270	1.1600	36.0
PCB-118	8.9	<0.0001 -1000	3.5050	12.7	5.8	0.0008-1071.4	6.9000	7.4	16.8	0.0009-487.1	10.000	21.4
PCB-123	25.7	<0.0001 -1000	1.5600	16.1	42.5	<0.0001 -5357.1	7.3000	53.0	47.3	<0.0001 -180	1.0000	33.3
PCB-156	9.6	0.0006-200	2.9900	15.0	13.1	0.0002-1071.4	10.000	9.3	20.0	<0.0001 -60	10.000	49.9
PCB-157	15.9	0.0001-590	0.7000	10.5	28.0	0.004-1071.4	5.0000	19.0	33.3	<0.0001 -90	2.0000	45.0
PCB-167	11.2	0.0006-250	1.6000	12.5	22.4	<0.0001 -2142.9	7.9000	13.6	23.6	<0.0001 -80	10.000	55.3
PCB-189	25.6	<0.0001 -350	1.2000	16.2	37.5	<0.0001 -1071.4	5.0000	25.7	42.6	<0.0001 -157.9	2.0000	44.2
PCB-126	8.0	<0.0001 -1.3	0.0463	8.0	13.4	0.0011-10.4	0.1000	1.7	33.5	0.0001-2.1	0.1000	21.3
PCB-169	14.4	<0.0001 -8.5	0.0493	12.2	23.3	0.0018-17.2	0.1246	7.7	51.2	0.0009-3.3	0.0400	17.5
PCB-77	5.9	<0.0001 -77.5	0.4922	15.7	15.9	0.0068-160.1	1.4650	26.0	10.3	<0.0001 -64.6	0.5000	19.8
PCB-81	23.0	<0.0001 -26.4	0.1000	20.9	37.9	0.001-35	0.3100	33.8	42.8	0.0001-71	0.0570	20.9

(a): N = number of analytical results. (b): % LC: percentage of left-censored results. (c): Range: minimum and maximum LOD/LOQ expressed in pg/g. (d): P50: median LOD/LOQ expressed in pg/g. (e): %Q: percentage of quantified results which stand below the median LOD/LOQ of censored results.

Table 10: Proportion of left-censored results and distribution of the LOQ/LOD for NDL-PCBs.

	Expressed on whole weight					Expressed on fat basis					Expressed on 12% moisture				
Congener	N(a)	% LC(b)	Range(c)	P50(d)	%Q(e)	N(a)	% LC(b)	Range(c)	P50(d)	%Q(e)	N(a)	% LC(b)	Range(c)	P50(d)	%Q(e)
PCB-101	6,714	32.4	<0.001-1.0	0.200	30.6	10,413	26.2	<0.001-2307.7	0.323	46.9	2,054	38.8	<0.001-0.4	0.1	40.6
PCB-138	6,714	27.9	<0.001-1.2	0.200	23.8	10,413	15.5	0.001-2000	0.962	29.9	2,054	37.4	<0.001-0.4	0.1	31.5
PCB-153	6,714	26.1	<0.001-1.3	0.200	21.1	10,413	14.3	<0.001-2000	0.838	22.5	2,054	37.0	<0.001-2	0.1	29.7
PCB-180	6,714	30.4	<0.001-1.5	0.100	26.1	10,413	16.8	<0.001-2000	0.768	35.0	2,054	40.1	<0.001-2	0.1	42.9
PCB-28	6,714	36.6	<0.001-1	0.240	57.4	10,413	24.1	<0.001-3076.9	0.500	39.8	2,054	39.4	<0.001-2	0.1	37.7
PCB-52	6,714	34.6	<0.001-1	0.200	40.6	10,413	25.8	<0.001-2307.7	0.500	94.8	2,054	39.5	<0.001-0.4	0.1	43.9
PCB-170	1,339	53.3	<0.001-0.3	0.088	29.4	1,132	36.0	<0.001-160	0.051	33.3	23	8.7	0.009-0.01	0.009	0.0
PCB-128	356	0.6	<0.001-0.01	0.006	1.1	31	29.0	0.004-2.8	0.005	0.0	-	-	-	-	-
PCB-18	356	7.6	<0.001-0.2	0.008	11.9	31	71.0	0.005-8.8	0.057	66.7	-	-	-	-	-
PCB-110	310	0.6	<0.005	0.003	1.0	31	61.3	0.005-18	0.062	41.7	-	-	-	-	-
PCB-141	310	1.6	<0.002	0.001	1.3	31	71.0	0.005-4.7	0.033	22.2	-	-	-	-	-
PCB-183	310	0.3	0.001	0.001	0.0	31	16.1	0.004-2.2	0.015	7.7	-	-	-	-	-
PCB-187	310	0.3	0.002	0.002	0.0	31	54.8	0.005-4.6	0.021	7.1	-	-	-	-	-
PCB-194	310	5.5	<0.006	0.001	0.7	31	45.2	0.003-1.5	0.007	17.6	-	-	-	-	-
PCB-206	310	13.5	<0.001-0.2	0.008	6.0	31	90.3	0.003-2.4	0.008	0.0	-	-	-	-	-
PCB-209	310	12.9	<0.01	0.002	2.6	31	74.2	0.002-0.8	0.004	0.0	-	-	-	-	-
PCB-33	310	5.8	<0.04	0.002	4.1	31	77.4	0.005-11	0.025	28.6	-	-	-	-	-
PCB-66	310	0.3	0.002	0.002	0.0	31	32.3	0.006-9.1	0.032	23.8	-	-	-	-	-
PCB-60	309	0.3	0.001	0.001	0.0	31	29.0	0.003-1.4	0.006	9.1	-	-	-	-	-
PCB-122	236	3.4	<0.001	<0.001	0.0	31	93.5	0.001-1.1	0.002	0.0	-	-	-	-	-
PCB-49	236	0.4	0.002	0.002	0.0	31	74.2	0.004-3.5	0.020	12.5	-	-	-	-	-
PCB-51	235	5.5	<0.019	0.003	17.6	31	41.9	0.002-2.2	0.003	0.0	-	-	-	-	-
PCB-31/PCB-99*	120	5.8	0.001-0.03	0.003	6.2	31	6.5	0.003-2.4	0.013	0.0	-	-	-	-	-
PCB-129/PCB-74*	74	17.6	<0.001-0.01	0.001	4.9	31	12.9	0.003-1.7	0.003	0.0	-	-	-	-	-
PCB-151/PCB-47*	74	1.4	<0.001	<0.001	2.7	31	16.1	0.003-3.4	0.011	0.0	-	-	-	-	-
PCB-185	74	48.6	<0.008	<0.001	2.6	-	-	-	-	-	-	-	-	-	-
PCB-191	74	5.4	<0.003	0.001	8.6	-	-	-	-	-	-	-	-	-	-
PCB-193	74	25.7	<0.008	0.001	3.6	-	-	-	-	-	-	-	-	-	-
PCB-201	74	24.3	<0.007	0.001	5.4	-	-	-	-	-	-	-	-	-	-
PCB-202	74	1.4	0.001	0.001	2.7	-	-	-	-	-	-	-	-	-	-
PCB-203	74	16.2	<0.003	<0.001	0.0	-	-	-	-	-	-	-	-	-	-
PCB-208	74	70.3	<0.001-0.16	0.001	13.6	-	-	-	-	-	-	-	-	-	-
PCB-41	74	5.4	0.002-0.003	0.003	1.4	-	-	-	-	-	-	-	-	-	-
PCB-44	74	2.7	0.003-0.006	0.004	4.2	-	-	-	-	-	-	-	-	-	-
PCB-87	74	1.4	<0.001	<0.001	0.0	-	-	-	-	-	-	-	-	-	-

(a): N: number of analytical results. (b): % LC: percentage of censored results. (c): Range: minimum and maximum LOD/LOQ expressed in µg/kg. (d): P50: median LOD/LOQ expressed in µg/kg. (e): %Q: percentage of quantified results below the median LOD/LOQ of censored results. *: the data expressed on a whole weight basis refer to the first mentioned congener (no result expressed on a fat basis for this congener), the data expressed on a fat weight basis refer to the second mentioned congener (no result expressed on a whole weight basis for this congener).

Table 11: Distribution of the sum of dioxins and DL-PCBs levels expressed in pg TEQ_{WHO05}/g across food/feed groups.

Food / Feed group	ER	N(a)	LC(%)(b)	Lower bound estimate Mean(c)	P50(d)	P95(d)	P99(d)	Upper bound estimate Mean(c)	P50(d)	P95(d)	P99(d)
Fat of pig	lw	255	15.3%	0.09	0.03	0.30	0.80	0.20	0.16	0.42	0.88
Fat of poultry	lw	149	4.7%	0.39	0.17	1.36	2.64	0.49	0.26	1.59	2.64
Fat ruminants	lw	370	1.9%	0.82	0.60	2.24	3.44	0.91	0.66	2.37	3.51
Fish liver and derived products	ww	84	0.0%	28.25	16.98	81.35	118.82	28.28	16.99	81.36	118.83
Fruits, vegetables and cereals	ww	256	2.7%	0.03	0.00	0.10	0.64	0.05	0.02	0.22	0.64
Hen eggs and egg products	lw	1,154	0.8%	1.54	0.51	5.12	11.95	1.62	0.61	5.16	11.96
Infant and baby foods	ww	414	2.2%	0.01	0.00	0.03	0.08	0.03	0.02	0.08	0.13
Liver terrestrial animals	lw	170	0.0%	10.84	3.20	57.41	113.04	10.98	3.41	57.41	113.04
Marine oil	lw	91	0.0%	1.25	0.66	4.79	7.77	1.40	0.78	4.91	7.88
Meat bovine animals and sheep	lw	412	0.0%	1.92	1.28	5.42	11.17	2.01	1.36	5.54	11.43
Meat pigs	lw	169	0.0%	0.22	0.02	0.78	5.55	0.31	0.11	0.79	5.58
Meat poultry	lw	129	0.0%	0.89	0.43	2.60	11.75	0.99	0.56	2.79	11.75
Muscle meat eel	ww	464	0.0%	9.70	5.66	33.93	44.04	9.76	5.76	33.94	44.04
Muscle meat fish	ww	3,821	0.7%	2.49	0.94	10.67	19.41	2.50	0.95	10.68	19.41
Other food products	-*	975	2.8%	2.47	0.65	8.12	31.13	2.57	0.75	8.30	31.13
Raw milk and dairy products	lw	1,422	1.3%	1.81	0.71	4.10	10.10	1.91	0.77	4.36	10.11
Vegetable oils and fats	lw	133	0.0%	0.10	0.04	0.42	0.51	0.18	0.13	0.50	0.61
Additives binders and anti-caking agents	dw	18	5.6%	0.29	0.22	0.77	0.77	0.38	0.33	0.82	0.82
Additives compounds of trace elements	dw	66	0.0%	0.03	0.01	0.13	0.37	0.09	0.05	0.20	0.37
Animal fat	dw	29	0.0%	0.55	0.41	1.71	2.02	0.65	0.51	1.89	2.03
Compound feed, excl. Fur animals, pets and fish	dw	905	1.8%	0.12	0.01	0.60	2.56	0.17	0.05	0.62	2.57
Feed for fur animals, pets and fish	dw	482	0.4%	1.21	0.99	3.03	4.42	1.24	1.02	3.03	4.43
Feed materials of mineral origin	dw	144	4.9%	0.04	0.01	0.18	0.63	0.09	0.06	0.30	0.71
Feed materials of plant origin, oils excluded	dw	966	2.3%	0.24	0.02	0.44	2.96	0.30	0.10	0.52	2.96
Feed not specified	dw	46	0.0%	0.92	0.82	2.13	3.09	0.97	0.83	2.15	3.75
Fish oil	dw	192	0.0%	8.55	7.24	23.15	32.73	8.61	7.28	23.17	32.73
Fish, other aquatic animals, their product	dw	295	0.3%	0.96	0.81	2.11	4.31	1.00	0.85	2.24	4.33
Other feed additives	dw	31	6.5%	0.66	0.01	1.10	18.51	0.73	0.12	1.12	18.58
Other land animal products	dw	38	5.3%	0.03	0.00	0.12	0.39	0.12	0.11	0.26	0.46
Premixtures	dw	83	1.2%	0.09	0.01	0.18	2.39	0.15	0.08	0.27	2.39
Vegetable oils and their by-products	dw	34	0.0%	0.60	0.18	6.40	7.67	0.74	0.37	6.41	7.73

(a): number of samples. (b): percentage of censored results. (c): mean contamination. (d): P50, P95, P99: 50^{th}, 95^{th} and 99^{th} percentiles of contamination. -*: results in this category were expressed either on fat, either on whole weight basis. **Reminder: in case of too few observations (less than 60 observations for the 95th percentile and less than 300 observations for the 99th percentile), the estimation of high percentiles may be biased and must consequently be interpreted cautiously.**

Table 12: Distribution of the sum of the 6 NDL-PCB indicators levels expressed in µg/kg across food/feed groups.

Food / Feed group	ER	N[(a)]	LC (%)[(b)]	Lower bound estimate				Upper bound estimate			
				Mean[(c)]	P50[(d)]	P95[(d)]	P99[(d)]	Mean[(c)]	P50[(d)]	P95[(d)]	P99[(d)]
Fat of pig	lw	361	26.9%	0.86	0.33	2.45	9.01	1.08	0.50	2.45	9.80
Fat of poultry	lw	150	3.3%	2.37	0.77	10.73	17.00	2.54	0.83	11.40	17.00
Fat ruminants	lw	478	15.3%	3.74	1.40	14.00	41.40	3.98	1.49	14.00	43.30
Fish liver and derived products	ww	121	0.8%	249.19	189.00	736.90	870.00	249.35	189.00	736.90	870.91
Fruits, vegetables and cereals	ww	297	20.2%	0.11	0.03	0.24	2.02	0.18	0.08	0.38	2.02
Hen eggs and egg products	lw	1,015	13.6%	11.00	2.31	56.10	107.40	12.27	3.07	58.80	107.40
Infant and baby foods	ww	130	19.2%	0.82	0.12	3.67	16.68	0.86	0.15	3.67	16.68
Liver terrestrial animals	lw	125	4.8%	13.79	4.75	54.00	96.00	14.67	4.85	58.50	97.50
Marine oil	lw	62	0.0%	29.02	13.12	168.43	217.93	29.30	13.70	168.43	217.93
Meat bovine animals and sheep	lw	351	16.8%	8.39	4.93	25.30	63.20	9.70	5.36	30.30	68.20
Meat pigs	lw	273	45.8%	3.39	0.37	8.15	28.19	4.26	1.05	10.10	28.19
Meat poultry	lw	395	58.0%	2.56	0.00	11.09	55.00	22.64	9.74	83.00	100.00
Mixed animal fats	lw	1	100.0%	0.00	0.00	0.00	0.00	0.93	0.93	0.93	0.93
Muscle meat eel	ww	325	2.5%	198.57	48.18	867.00	1427.07	198.75	48.18	867.00	1427.07
Muscle meat fish	ww	5,367	23.7%	14.23	2.88	58.62	205.00	14.82	3.79	58.62	205.03
Other food products	-*	1,553	44.5%	19.46	0.36	61.40	288.60	22.17	4.60	62.00	288.60
Raw milk and dairy products	lw	6,046	3.1%	8.59	8.55	15.68	20.97	9.00	8.93	15.93	21.01
Vegetable oils and fats	lw	77	13.0%	3.15	0.36	7.33	149.88	3.25	0.45	7.42	149.88
Additives binders and anti-caking agents	dw	12	83.3%	0.03	0.00	0.21	0.21	0.53	0.60	0.60	0.60
Additives compounds of trace elements	dw	72	55.6%	0.13	0.00	0.91	0.91	0.41	0.35	0.91	0.91
Animal fat	dw	21	4.8%	3.31	1.80	10.39	13.88	3.38	2.10	10.39	13.97
Compound feed, excl. Fur animals, pets and fish	dw	523	57.0%	1.49	0.00	12.10	24.51	1.76	0.60	12.10	24.51
Feed for fur animals, pets and fish	dw	294	7.1%	8.39	6.91	21.04	28.41	8.44	6.91	21.04	28.41
Feed materials of mineral origin	dw	127	53.5%	0.40	0.00	0.91	7.33	0.67	0.60	0.91	7.33
Feed materials of plant origin, oils excluded	dw	408	44.6%	0.37	0.03	1.11	4.80	0.58	0.36	1.19	4.80
Feed not specified	dw	22	31.8%	0.64	0.22	0.91	7.88	0.83	0.55	0.91	7.88
Fish oil	dw	163	1.2%	54.44	48.61	140.04	212.72	54.54	48.63	140.04	212.72
Fish, other aquatic animals, their product	dw	272	8.5%	5.07	3.68	11.67	28.10	5.16	3.68	11.67	28.10
Other feed additives	dw	15	60.0%	4.78	0.00	68.45	68.45	5.21	0.93	68.45	68.45
Other land animal products	dw	25	68.0%	0.19	0.00	0.91	2.81	0.63	0.60	0.93	2.81
Premixtures	dw	58	63.8%	0.10	0.00	0.91	0.91	0.40	0.60	0.91	0.91
Vegetable oils and their by-products	dw	42	23.8%	1.54	0.55	1.19	41.29	1.71	0.75	1.19	41.29

(a): number of samples. (b): percentage of censored results. (c): mean contamination +/ standard deviation. (d): P50, P95, P99: 50^{th}, 95^{th} and 99^{th} percentiles of contamination. -*: results in this category were expressed either on fat, either on whole weight basis. **Reminder: in case of too few observations (less than 60 observations for the 95th percentile and less than 300 observations for the 99th percentile), the estimation of high percentiles may be biased and must consequently be interpreted cautiously.**

Table 13: Distribution of the sums of dioxins and DL-PCBs levels and of the 6 NDL-PCB indicators levels across the detailed categories of the "other food products" group.

Food / Feed group	ER	N(a)	LC (%)(b)	Lower bound estimate				Upper bound estimate			
				Mean(c)	P50(d)	P95(d)	P99(d)	Mean (c)	P50(d)	P95(d)	P99(d)
Dioxins and DL-PCBs in pg TEQ_{WHO05} / g											
Meat products											
- Edible offal from farmed mammals other	lw	152	0.0%	5.03	1.04	21.72	88.58	5.13	1.14	21.73	88.58
- Game mammals and birds	lw	147	0.0%	3.30	1.93	8.22	34.51	3.46	2.09	8.80	34.52
- Livestock meat other	lw	80	2.5%	4.47	0.33	5.91	285.19	4.56	0.44	6.06	285.19
- Transformed and unspecified meat products	lw	130	0.0%	0.78	0.42	2.44	5.68	0.84	0.48	2.69	5.70
Unspecified fish and seafood products	ww	105	10.5%	0.79	0.19	3.00	10.50	0.82	0.19	3.01	10.55
Vegetable and animal fats not specified	lw	159	2.5%	2.14	0.75	10.64	23.94	2.25	0.94	10.72	23.95
Honey and sugars	ww	41	17.1%	0.00	0.00	0.02	0.05	0.05	0.04	0.17	0.17
Composite foods	ww	24	0.0%	1.88	0.05	10.46	10.72	1.89	0.06	10.46	10.73
Products for special nutritional use	ww	135	2.2%	1.71	0.78	6.49	13.29	1.88	0.92	7.10	13.73
Beverages	ww	2	0.0%	0.11	0.11	0.22	0.22	0.13	0.13	0.25	0.25
NDL-PCB indicators in µg/kg											
Meat products											
- Edible offal from farmed mammals	lw	282	31.2%	2.79	0.83	13.77	33.06	5.33	2.23	14.34	33.65
- Game mammals and birds	lw	219	33.8%	17.58	2.46	110.00	204.00	22.76	8.37	115.00	208.00
- Livestock meat other	lw	35	60.0%	1.97	0.00	11.89	15.10	6.46	3.78	30.69	33.33
- Transformed and unspecified meat products	lw	256	37.1%	40.55	1.15	89.48	1277.80	43.57	6.00	89.48	1277.80
Unspecified fish and seafood products	ww	219	57.1%	28.10	0.00	37.82	595.54	28.25	0.14	37.82	595.54
Vegetable and animal fats not specified	lw	287	52.3%	10.49	0.00	62.30	150.25	14.72	6.00	67.30	150.85
Honey and sugars	ww	85	88.2%	0.10	0.00	0.16	6.50	1.92	0.93	6.00	6.50
Composite foods	ww	37	29.7%	14.34	0.53	63.31	71.48	14.62	0.93	63.31	71.48
Products for special nutritional use	ww	92	19.6%	59.95	3.37	261.93	1285.17	60.10	3.56	261.93	1285.17
Beverages	ww	41	82.9%	0.15	0.00	0.03	6.24	2.50	3.00	3.00	6.24

(a): number of samples. (b): percentage of censored results. (c): mean contamination +/ standard deviation. (d): P50, P95, P99: 50th, 95th and 99th percentiles of contamination. -*: results in this category were expressed either on fat, either on whole weight basis. **Reminder: in case of too few observations (less than 60 observations for the 95th percentile and less than 300 observations for the 99th percentile), the estimation of high percentiles may be biased and must consequently be interpreted cautiously.**

The quantification rate was lower for the six NDL-PCB indicators (82.6 %) than for dioxins and DL-PCBs, but more variable between the food groups. Whereas it was higher than 95 % in “Fat of poultry”, “Fish liver and derived products”, “Liver from terrestrial animals”, “Muscle meat from fishes other than eels” and “Raw milk and dairy products”, it was around 50 % for “Meat pigs”, “Meat poultry” and “Other food products”. As previously observed (EFSA, 2010b), two food groups were clearly distinct from the others: “Fish liver and derived products” and “Muscle meat from eels” with mean levels for the sum of the six indicators higher than 200 $\mu g/kg_{ww}$. Five groups had mean levels between 10 and 30 $\mu g/kg_{lw/ww}$: “Meat poultry”, ”Other food products”, “Muscle from fishes other than eels”, “Liver from terrestrial animal” and “Hen eggs and egg products”. The high levels observed in the “Other food products” are explained by the “Products for special nutritional use”, “Unspecified fish and seafood products”, “Game mammals and birds” and “Transformed and unspecified meat products”, which contained on average more than 20 $\mu g/kg_{lw/ww}$ of the six NDL-PCB indicators. A high variability was noticed for “Vegetable oils and fats” with a few samples highly contaminated.

The quantification rate of the six NDL-PCB indicators varied considerably between the feed groups. Whereas it was higher than 95 % for “Animal fat” and “Fish oil”, it didn’t exceed 20 % for “Additives binders and anti-caking agents”. “Fish oil” was the most contaminated feed, followed by “Feed for fur animals, pets and fish”, “Other feed additives” and “Fish, other aquatic animals and their products“, with average levels higher than 5 $\mu g/kg_{dw}$. Similarly to the food group “Vegetable oils and fats”, a high variability of contamination was observed for the feed group “Vegetable oils and their by-products”.

4.2.2. Contribution of the individual/group of congeners

Figure 1 illustrates the relative contribution of PCDDs, PCDFs, mono-*ortho* PCBs and non-*ortho* PCBs, expressed in TEQ_{WHO05}, to the lower and upper bound estimates of the total TEQ $_{WHO05}$ of dioxins and DL-PCBs in food and feed. Appendix A presents the same figures considering only the 5 % most contaminated samples.

Overall, the main contributors were the non-*ortho* PCBs, representing between 21.0 and 74.9 % of the total TEQ $_{WHO05}$ of dioxins and DL-PCBs in food, followed by the PCDDs and PCDFs which together represented between 12.4 and 73.2 % of the total TEQ_{WHO05}. The mono-*ortho* PCBs didn’t represent more than 12 % of the total TEQ_{WHO05}. When looking at the most contaminated samples, the relative contribution of the non-*ortho* PCBs increased, from 34.2 % to 86.1 % depending on the food group. The food groups with the highest levels of non-*ortho* PCBs (more than half the total contamination) were products from aquatic animals and from ruminants.

The contamination profile of the feed groups was quite similar to what was observed in food, except for four of the feed groups. In the “Additives binders and anti-caking agents”, the PCDDs represented the major contributor with more than 80 % of the total TEQ_{WHO05}. In the “Additives compounds of trace element”, “Other feed additives” and “Feed materials of plant origin, oils excluded”, the PCDFs were the major contributor with between 29.0 and 92.4 % of the total TEQ_{WHO05}. As observed in the food groups, the most contaminated feed group samples had an increased relative contribution of non-*ortho* PCBs to the total TEQ_{WHO05}, up to two times higher than the average contribution.

Figure 2 illustrates the average relative contribution of each individual indicator to the sum of the six NDL-PCB indicators for the lower and upper bound estimates in food and feed. Appendix B presents the same figures considering only the 5 % most contaminated samples.

Except for “Fruit, vegetables and cereals”, the major contributor was PCB-153, followed by PCB-138 and PCB-180, which together represented between 43.7 and 97.8 % of the sum of the 6 NDL-PCB indicators in food. The contribution of the three other NDL-PCBs varied between 0.3 to 34.3 % according to the food group. In “Fruit, vegetables and cereals”, the major contributor was PCB-128, which represented around one third of the sum, the five other NDL-PCBs being almost equally distributed. The most contaminated samples had similar profiles of contamination.

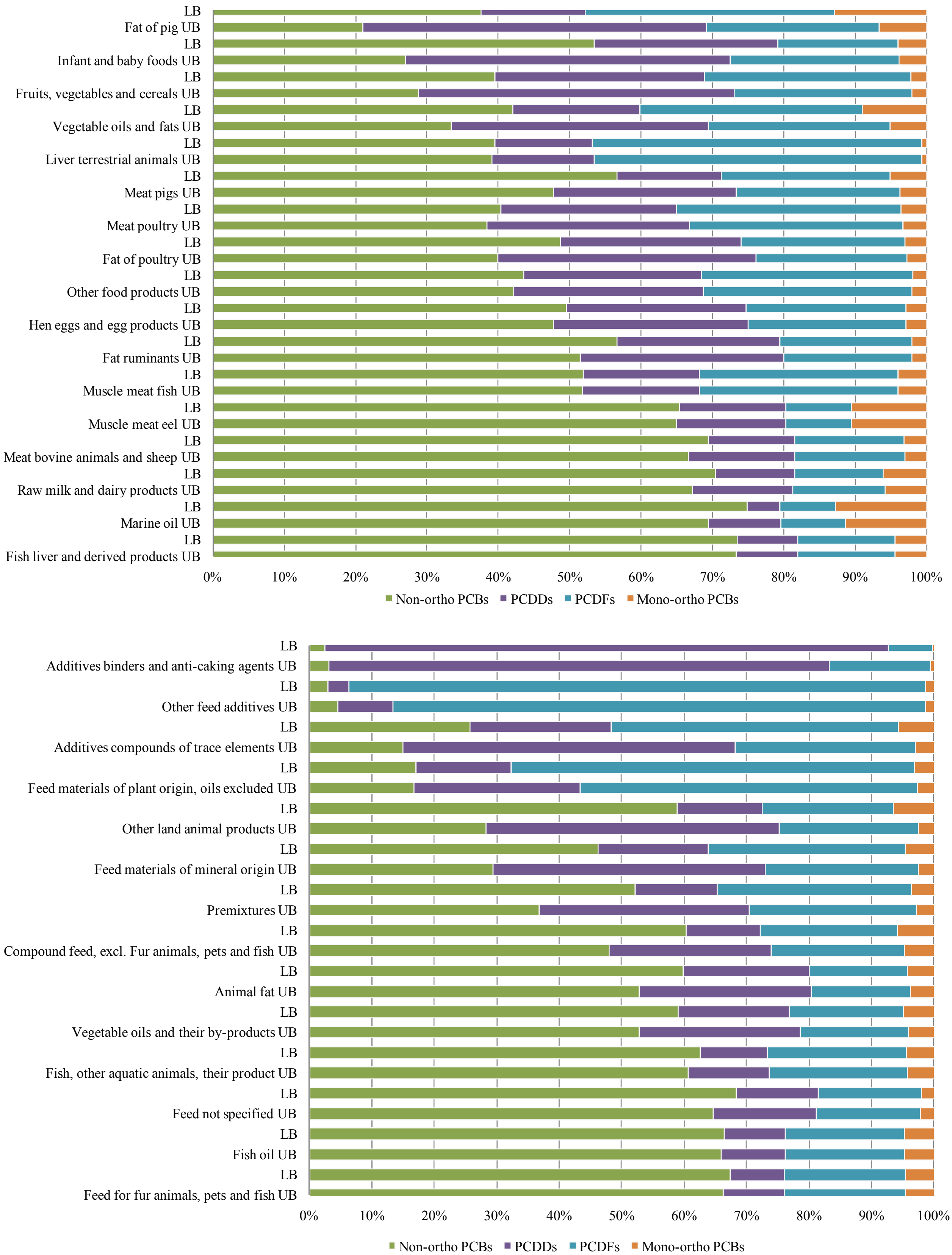

Figure 1: Relative contribution of PCDDs, PCDFs, non-*ortho* PCBs and mono-*ortho* PCBs to the total TEQ_{WHO05} of dioxins and DL-PCBs in food (top) and feed (bottom) at lower (LB) and upper (UB) bound concentrations.

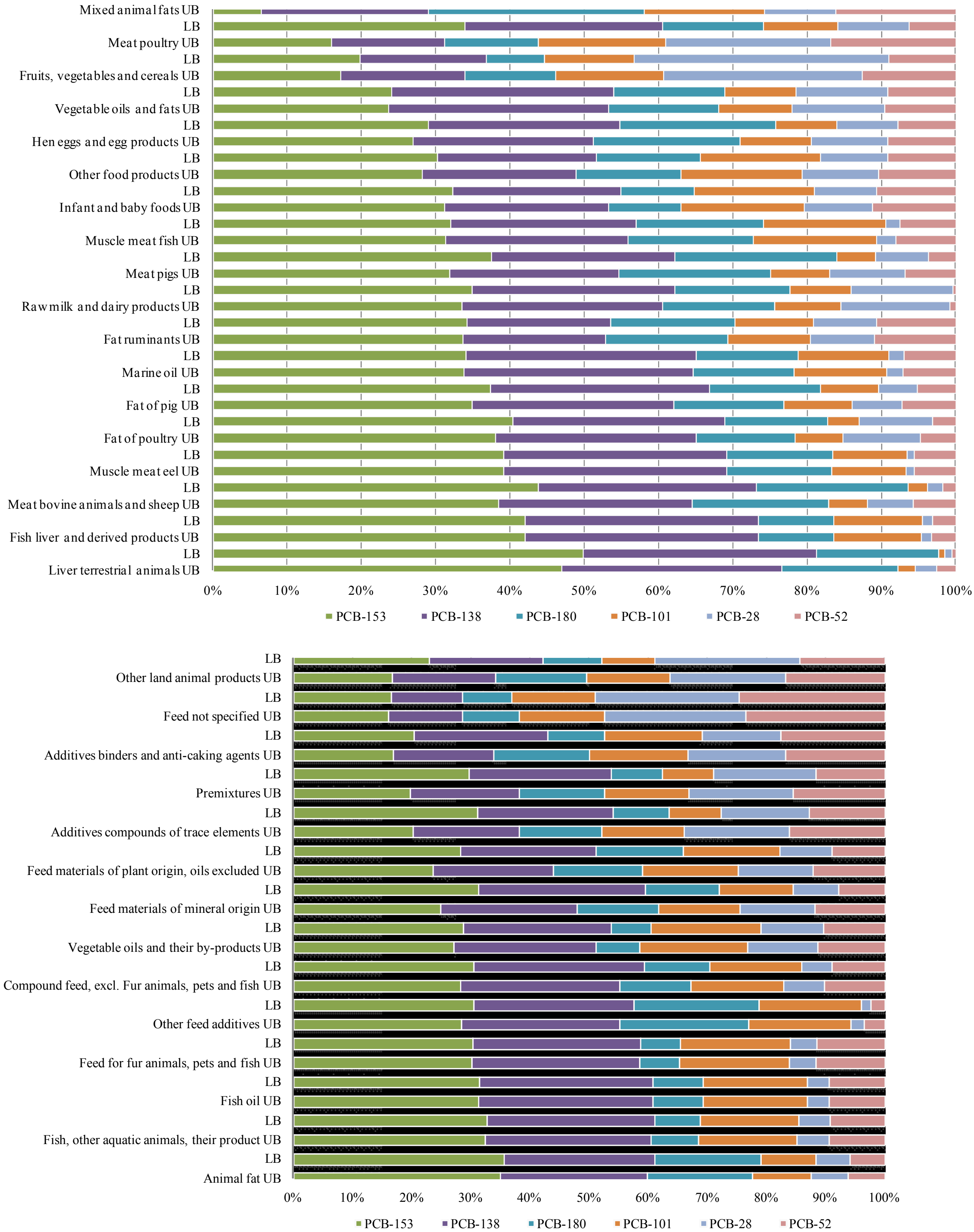

Figure 2: Relative contribution of each indicator to the total level of the six NDL-PCB indicators in food (top) and feed (bottom) at lower (LB) and upper (UB) bound concentrations.

Also in feed, the major contributor was PCB-153 (between 16 and 36 % of the sum of the six indicator PCBs), closely followed by PCB-138 (between 12 and 29 %). The contributions of the four other PCBs varied more greatly according to the feed groups. PCB-180 and PCB-101 contributed at least to 6 % and up to 20 % of the total level represented by the six indicators PCBs. PCB-28 and PCB-52 contributed at least to 2 %, but could represent up to respectively 28 % and 24 % of the sum of the six indicator PCBs. The most contaminated samples had quite similar profiles of contamination.

The contamination profiles are consistent with those described in previous reports (EFSA, 2010b; c).

4.2.3. Comparison to action and maximum levels

Tables 14 and 15 show an estimation of the percentage of results exceeding the MLs and ALs defined for dioxins and DL-PCBs across the food and feed groups.

Taking into account all food groups, 5.4 % of sample results exceeded the MLs for PCDD/Fs and 9.7 % the MLs for sum of dioxins and DL-PCBs. This is quite comparable with the 8 % of sample results exceeding MLs estimated for the sum of dioxins and DL-PCBs in the previous report (EFSA, 2010c), although MLs have been revised since then. The highest exceedance was found for "Fish liver and derived products", followed by "Muscle meat from eels", both wild caught and farmed, and "Liver from terrestrial animals", at between 21.2 and 44.0 % when considering the sum of dioxins and DL-PCBs. "Meat from fishes other than eels" were also found with more than 10 % of the results above the MLs for the sum of dioxins and DL-PCBs. No result was higher than the MLs for the sum of dioxins and DL-PCBs for "Fat of pig", "Vegetable oils fats", "Fat of Poultry" and "Infant and baby foods". Nevertheless, for these last two food groups, some results exceeded the ML defined for PCDD/Fs. The percentage of results above the ML was significantly higher when considering the sum of dioxins and DL-PCBs compared to PCDD/Fs for "Meat bovine animals and sheep" and "Muscle meat from eels", both wild caught and farmed, and for "Farmed fishes other than eels". ALs being below the MLs, this resulted in a higher exceedance rate at the food group level. "Fruits, vegetables and cereals" is the only food group which has ALs but no ML. Respectively 1.3 % and 5.4 % of the sample results of "Fruits, vegetables and cereals" exceeded the ALs defined for PCDD/Fs and DL-PCBs.

The percentage of results exceeding the MLs was lower for the feed groups: about 2.5 % for PCDD/Fs and 2.3 % for the sum of dioxins and DL-PCBs. The highest percentages of results above the MLs were observed in "Fish oil" and "Vegetable oils and their by-products". All sample results available for "Additives compounds of trace elements" and "Other land animal products" were below the MLs and ALs. The high percentage of results above the ML and AL defined for PCDD/Fs observed for "Additives binders and anti-caking agents" (respectively 11.1 and 38.9 %) should be interpreted with caution due to the limited number of samples available.

Table 16 shows an estimation of the percentage of results exceeding the MLs defined for the sum of the six NDL-PCB indicators across the food and feed groups. On overall, respectively 2.4 and 3.0 % of sample results exceeded the MLs for the feed and food groups. Concerning the food groups, as for dioxins and DL-PCBs, the highest exceedance was found for "Fish liver and derived products", followed by "Muscle meat from wild caught eels", at between 22.5 and 49.6 %. "Meat from poultry" and "Liver from terrestrial animals" were also found with more than 10 % of the results above the MLs. Less than 1 % of the sample results were higher than the ML for fats (pig, poultry, ruminant, mixed animal fat), as well as for meat from pig, raw milk and dairy products, and farmed fishes other than eels. The null percentage of results above the ML estimated for farmed eels should be interpreted cautiously due to the very low number of samples available.

Less than 10 % of the results were higher than the ML whatever the feed group. The highest rate was observed for "Animal fat" (9.5 %) but may be biased due to the limited number of data available, followed by "Compound feeds, excluded feed for fur animals, pets and fish", "Fish oil", "Vegetable oils and their by-products" and "Feed for pets and fish", at between 2.1 and 5.5 %. It was less than 1 % for the other feed groups.

Table 14: Percentage of samples with dioxins and DL-PCBs levels higher than the maximum limit and action level across the food groups.

Food group	N(a)	Maximum limits				Action levels			
		PCDD/Fs		Dioxins and DL-PCBs		PCDD/Fs		DL-PCBs	
		ML(b)	Perc [IC95](c)	ML(b)	Perc [IC95](c)	AL(d)	Perc [IC95](c)	AL(d)	Perc [IC95](c)
Fat of pig	255	1.0	0 [0; 0]	1.25	0 [0; 0]	0.75	0.4 [0; 1.2]	0.5	0 [0; 0]
Fat of poultry	149	1.75	0.7 [0; 2]	3.0	0 [0; 0]	1.25	1.3 [0; 3.2]	0.75	5.4 [1.7; 9]
Fat ruminants	370	2.5	0 [0; 0]	4.0	0.5 [0; 1.3]	-	-	-	-
Fish liver and derived products	84	-	-	20.0	44 [33.2; 55.3]	-	-	-	-
Fruits, vegetables and cereals	256	-	-	-	-	0.3	0.8 [0; 1.9]	0.1	4.3 [1.8; 6.8]
Hen eggs and egg products	1,154	2.5	5.1 [3.8; 6.4]	5.0	4.7 [3.5; 5.9]	1.75	9.2 [7.5; 10.9]	1.75	6.6 [5.2; 8]
Infant and baby foods	414	0.1	1 [0; 1.9]	0.2	0 [0; 0]	-	-	-	-
Liver terrestrial animals	170	4.5	20.6 [14.5; 26.7]	10.0	21.2 [15; 27.3]	-	-	-	-
Marine oil	91	1.75	1.1 [0; 6.0]	6.0	3.3 [0.7; 9.3]	-	-	-	-
Meat bovine animals and sheep	412	2.5	2.2 [0.8; 3.6]	4.0	8.3 [5.6; 10.9]	1.75	4.6 [2.6; 6.6]	1.75	15.5 [12; 19]
Meat pigs	169	1.0	1.2 [0; 2.8]	1.25	3 [0.4; 5.5]	0.75	2.4 [0.1; 4.7]	0.5	3 [0.4; 5.5]
Meat poultry	129	1.75	3.1 [0.1; 6.1]	3.0	3.1 [0.1; 6.1]	1.25	3.1 [0.1; 6.1]	0.75	9.3 [4.3; 14.3]
Muscle meat eel	464	-	-	-	-	-	-	-	-
- *Wild caught eel*	458	3.5	18.6 [15; 22.1]	10.0	32.8 [28.5; 37]	-	-	-	-
- *Farmed eel*	6	3.5	0 [0; 45.9]	6.5	33.3 [4.3; 77.7]	1.5	66.7 [22.3; 95.7]	2.5	66.7 [22.3; 95.7]
Muscle meat fish	3,821	3.5	7.5 [6.6; 8.3]	6.5	10.6 [9.6; 11.6]	-	-	-	-
- *Wild caught freshwater fish*	334	3.5	6.6 [3.9; 9.2]	6.5	10.2 [6.9; 13.4]	-	-	-	-
- *Other muscle meat*	3,487	3.5	7.5 [6.7; 8.4]	6.5	10.7 [9.6; 11.7]	-	-	-	-
o *Farmed*	512	3.5	3.1 [1.6; 4.6]	6.5	9.4 [6.9; 11.9]	1.5	9.8 [7.2; 12.3]	2.5	9.8 [7.2; 12.3]
o *Wild caught*	2,975	3.5	8.3 [7.3; 9.3]	6.5	10.9 [9.8; 12]	-	-	-	-
Raw milk and dairy products	1,422	2.5	0.9 [0.4; 1.4]	5.5	0.5 [0.1; 0.9]	1.75	1.2 [0.6; 1.8]	2.0	1.4 [0.8; 2]
Vegetable oils and fats	133	0.75	0 [0; 0]	1.25	0 [0; 0]	-	-	-	-

(a): Number of samples. (b): Maximum limit on PCDD/Fs: sum of PCDDs and PCDFs compounds expressed in pg TEQ_{WHO05}/g ; on dioxins and DL-PCBs: sum of PCDDs, PCDFs, and DL-PCBs, expressed in pg TEQ_{WHO05}/g (Recommendation 2006/88/EC). (c): Perc: percentage of samples with levels higher than the limit, [IC95]: corresponding 95 % confidence interval. Example: 20.6 [14.5; 26.7] means that from the observations, it was estimated that 20.6% of the results were higher than the limit, and that on 95% of the time, the percentage of results higher than the limit would stand between 14.5 and 26.7%. (d): Action level on PCDD/Fs: sum of PCDDs and PCDFs compounds expressed in pg TEQ_{WHO05}/g ; on DL-PCBs: sum of DL-PCBs, expressed in pg TEQ_{WHO05}/g (Recommendation 2011/516/EC).

Table 15: Percentage of samples with dioxins and DL-PCBs levels higher than the maximum limit and action level across the feed groups.

Feed group	N[(a)]	Maximum limits				Action levels			
		PCDD/Fs		Dioxins and DL-PCBs		PCDD/Fs		DL-PCBs	
		ML[(a)]	Perc [IC95][(c)]	ML[(a)]	Perc [IC95][(c)]	AL[(d)]	Perc [IC95][(c)]	AL[(d)]	Perc [IC95][(c)]
Additives binders and anti-caking agents	18	0.75	11.1 [1.4; 34.7]	1.5	0 [0; 18.5]	0.5	38.9 [17.3; 64.3]	0.5	0 [0; 18.5]
Additives compounds of trace elements	66	1.0	0 [0; 6.44]	1.5	0 [0; 6.44]	0.5	0 [0; 6.44]	0.35	0 [0; 6.44]
Animal fat	29	1.5	3.4 [0.1; 17.7]	2.0	3.4 [0.1; 17.7]	0.75	3.4 [0.1; 17.7]	0.75	6.9 [0.9; 22.8]
Compound feed, excl. Fur an., pets and fish	905	0.75	1.2 [0.5; 1.9]	1.5	3.5 [2.3; 4.7]	-	-	0.5	4.8 [3.4; 6.1]
Feed for fur animals, pets and fish	482	-	-	-	-	-	-	-	-
- *Feed for fur animals*	4	-	-	-	-	-	-	-	-
- *Feed for pets and fish*	478	1.75	1 [0.1; 2]	5.5	1.3 [0.3; 2.3]	1.25	2.5 [1.1; 3.9]	2.5	2.5 [1.1; 3.9]
Feed materials of mineral origin	144	0.75	0 [0; 0]	1.0	0 [0; 0]	0.5	0 [0; 0]	0.35	2.1 [0; 4.4]
Feed materials of plant origin, oils excluded	966	0.75	2.2 [1.3; 3.1]	1.25	2.1 [1.2; 3]	0.5	3.2 [2.1; 4.3]	0.35	1.8 [0.9; 2.6]
Fish oil	192	5.0	14.1 [9.1; 19]	20.0	7.3 [3.6; 11]	4.0	19.3 [13.7; 24.9]	11.0	14.1 [9.1; 19]
Fish, other aquatic animals, their product	295	1.25	2 [0.4; 3.6]	4.0	1.4 [0; 2.7]	0.75	6.8 [3.9; 9.6]	2.0	3.7 [1.6; 5.9]
Other land animal products	38	0.75	0 [0; 9.3]	1.25	0 [0; 9.3]	0.5	0 [0; 9.3]	0.35	0 [0; 9.3]
Premixtures	83	1.0	0 [0; 4.5]	1.5	2.4 [0.3; 8.4]	0.5	2.4 [0.3; 8.4]	0.35	2.4 [0.3; 8.4]
Vegetable oils and their by-products	34	0.75	5.9 [0.7; 19.7]	1.5	5.9 [0.7; 19.7]	0.5	11.8 [3.3; 27.5]	0.5	8.8 [1.9; 23.7.4]

(a): Number of samples. (b): Maximum limit on PCDD/DFs: sum of PCDDs and PCFs compounds expressed in pg TEQ_{WHO05}/g ; on dioxins and DL-PCBs: sum of PCDDs, PCDFs, and DL-PCBs, expressed in pg TEQ_{WHO05}/g (Directive 2002/32/EC). (c): Perc: percentage of samples with levels higher than the limit, [IC95]: corresponding 95 % confidence interval. Example: 2 [0.4; 3.6] means that from the observations, it was estimated that 2% of the results were higher than the limit, and that on 95% of the time, the percentage of results higher than the limit would stand between 0.4 and 12.3%. (d): Action level on PCDD/DFs: sum of PCDDs and PCFs compounds expressed in pg TEQ_{WHO05}/g ; on DL-PCBs: sum of DL-PCBs, expressed in pg TEQ_{WHO05}/g (Directive 2002/32/EC).

Table 16: Percentage of samples with NDL-PCB indicators levels higher than the maximum limit across the food and feed groups.

Food group	N(a)	ML(b)	Perc [IC95](c)
Fat of pig	361	40	0 [0; 0]
Fat of poultry	150	40	0 [0; 0]
Fat ruminants	478	40	0.8 [0; 1.7]
Fish liver and derived products	121	200	49.6 [40.7; 58.5]
Fruits, vegetables and cereals	297	-	-
Hen eggs and egg products	1,015	40	5.1 [3.8; 6.5]
Infant and baby foods	130	1	6.2 [2; 10.3]
Liver terrestrial animals	125	40	11.2 [5.7; 16.7]
Marine oil	62	200	1.6 [0; 8.7]
Meat bovine animals and sheep	351	40	2.8 [1.1; 4.6]
Meat pigs	273	40	0.7 [0; 1.7]
Meat poultry	395	40	14.2 [10.7; 17.6]
Mixed animal fat	1	40	0 [0; 0]
Muscle meat eel	325	-	-
- *Wild caught eel*	316	300	22.5 [17.9; 27.1]
- *Farmed eel*	9	75	0 [0; 33.6]
Muscle meat fish	5,367	-	-
- *Wild caught freshwater fish*	492	125	2.4 [1.1; 3.8]
- *Other muscle meat*	4,875	75	3.4 [2.9; 4]
o *Farmed*	643	75	0 [0; 0]
o *Wild caught*	4,232	75	4 [3.4; 4.6]
Raw milk and dairy products	6,046	40	0.1 [0; 0.2]
Vegetable oils and fats	77	40	1.3 [0; 7.0]
Additives binders and anti-caking agents	12	10	0 [0; 26.5]
Additives compounds of trace elements	72	10	0 [0; 5.0]
Animal fat	21	10	9.5 [1.2; 30.4]
Compound feed, excl. Fur an., pets and fish	523	10	5.5 [3.6; 7.5]
Feed for fur animals, pets and fish	294	-	-
- *Feed for fur animals*	4	-	-
- *Feed for pets and fish*	290	40	2.1 [0.4; 3.7]
Feed materials of mineral origin	127	10	0.8 [0; 2.3]
Feed materials of plant origin, oils excluded	408	10	0.7 [0; 1.6]
Fish oil	163	175	3.1 [0.4; 5.7]
Fish, other aquatic animals, their product	272	30	0.7 [0; 1.8]
Other land animal products	25	10	0 [0; 13.7]
Premixtures	58	10	0 [0; 6.2]
Vegetable oils and their by-products	42	10	2.4 [0.1; 12.6]

(a): Number of samples. (b): Maximum limit: sum of the 6 NDL-PCBs indicators expressed in ng/g or µg/kg (Recommendation 2006/88/EC and Directive 2002/32/EC). (c): Perc: percentage of samples with levels higher than the limit, [IC95]: corresponding 95 % confidence interval. Example: 14.2 [10.7; 17.6] means that from the observations, it was estimated that 14.2% of the results were higher than the limit, and that on 95% of the time, the percentage of results higher than the limit would stand between 10.7 and 17.6%.

4.2.4. Evolution of contamination levels over time

The time trend analysis was performed on the following three food groups which were the best documented in terms of number of years covered, number of countries providing data and number of data available for each year:

- Hen eggs and egg products,
- Muscle meat from fishes other than eels,
- Raw milk and dairy products.

The group of "Other food products" was not taken into account due to the heterogeneity of the foods gathered in this group. In general, the feed groups were represented only from years 2002-2003 and after, and few data were available for year 2010. The number of years available was not considered as enough to conduct such analysis for the feed groups.

Figures 3 - 8 illustrate the annual distribution of results found for the selected groups. An overall decreasing tendency was observed for the median level of the sum of dioxins and DL-PCBs and of the sum of the six NDL-PCB indicators over the years. When taking the whole time series into the account, this decrease was statistically significant with the Mann-Kendall trend test in:

- "Raw milk and dairy products" for the sum of dioxins and DL-PCBs: 56 % reduction in 10 years with a starting median value estimated at 1.17 pg TEQ_{WHO05}/g_{lw},
- "Raw milk and dairy products" for the six NDL-PCB indicators : 64 % reduction in 15 years with a starting median value estimated at 9.95 µg/kg_{lw},
- "Muscle meat from fishes other than eels" for the sum of dioxins and DL-PCBs: 98 % reduction in 10 years with a starting median value estimated at 3.05 pg TEQ_{WHO05}/g_{ww}.

When restricting the analysis to the years with the most robust estimates, generally between 2002 or 2003 and 2010, the decrease is less important and not anymore statistically significant.

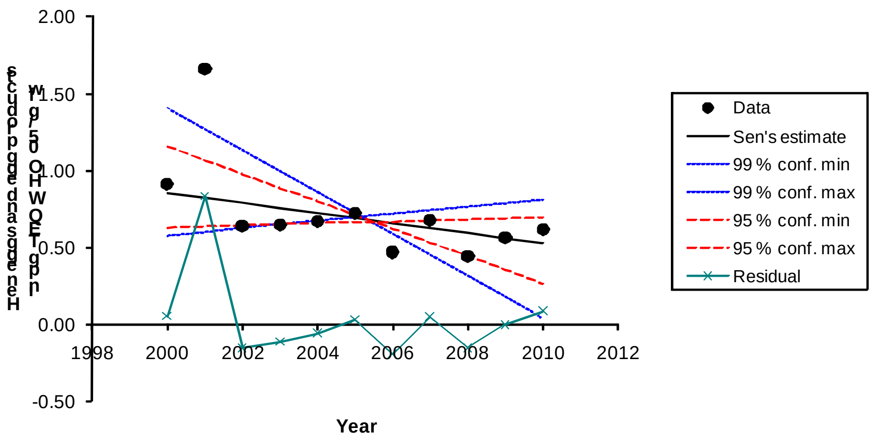

Figure 3: Evolution of the median level (UB) of dioxins and DL-PCBs in hen eggs and egg products throughout the years.

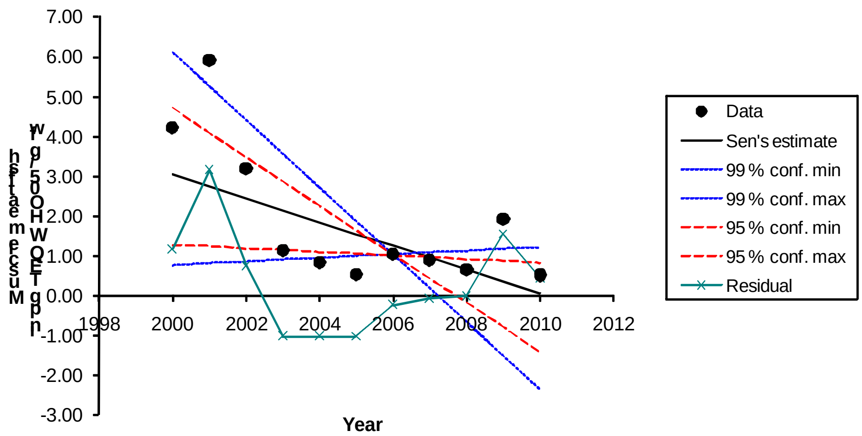

Figure 4: Evolution of the median level (UB) of dioxins and DL-PCBs in muscle meat from fishes other than eels throughout the years.

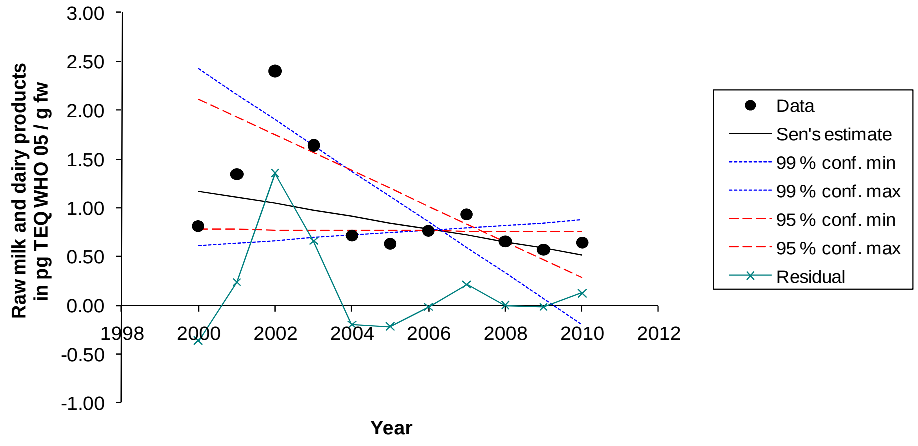

Figure 5: Evolution of the median level (UB) of dioxins and DL-PCBs in raw milk and dairy products throughout the years.

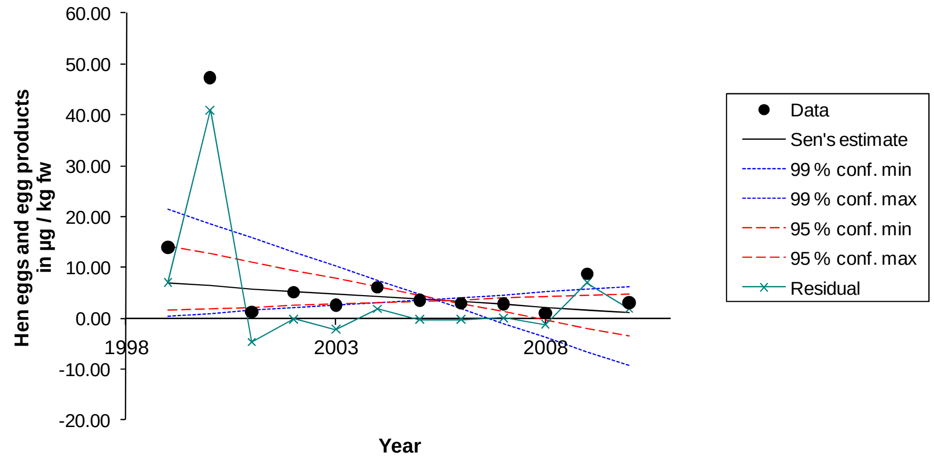

Figure 6: Evolution of the median level (UB) of the six NDL-PCB indicators in hen eggs and egg products throughout the years.

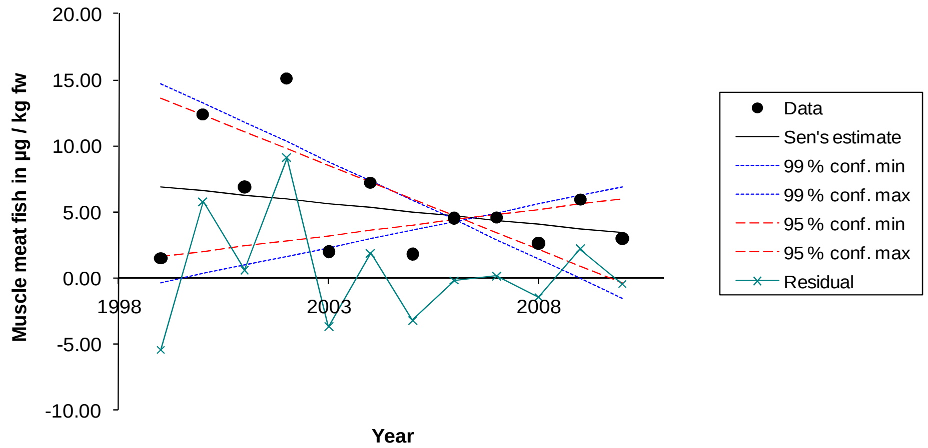

Figure 7: Evolution of the median level (UB) of six NDL-PCB indicators in muscle meat from fishes other than eels throughout the years.

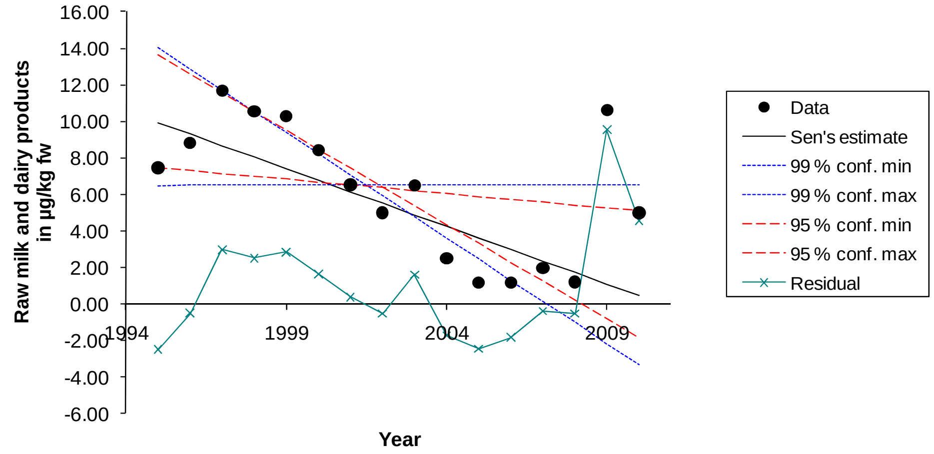

Figure 8: Evolution of the median level (UB) of six NDL-PCB indicators in raw milk and dairy products throughout the years.

It cannot be excluded that the heterogeneity in the foods constituting the groups, in the countries of origin covered and targeting strategies between the years, has influenced the observed trends, especially the estimation of the rates of decrease. For example, concerning the sum of the six NDL-PCB indicators in raw milk and dairy products (Figure 8), the observation outside the 99 % confidence interval for year 2009 appeared to be driven by samples from Germany and Czech Republic. These samples represented 62 % of the dataset available that year and were on average three times more contaminated than those from the other countries.

Moreover, the analysis cannot clearly attribute the reason for the possible change since it can be due to risk management measures, but also to improvements throughout the years in both analytical methods and/or sampling designs of the monitoring programs.

4.2.5. Special focus

4.2.5.1. Contribution of NDL-PCBs other than the six indicators

Some data were available for 33 NDL-PCBs other than the six indicators (PCB-18, -31, -33, -41, -44, -47, -49, -51, -60, -66, -74, -87, -99, -110, -122, -128, -129, -141, -149, -151, -170, -183, -185, -187, -191, -193, -194, -201, -202, -203, -206, -208 and -209). PCB-170 was the congener most frequently analysed. Appendix C illustrates the contribution of each individual congener to the sum of all the measured congeners at the sample level.

Up to 19 NDL-PCBs were analysed in “Vegetable oils and fats”, “Hen eggs and eggs products”, “Meat poultry”, “Meat pigs”, “Raw milk and dairy products”, “Meat from bovine animals and sheep” and “Marine oil”. They were found to contribute to 35-45 % of the sum of the measured NDL-PCB levels (including the 6 NDL-PCB indicators) in “Meat pigs”, “Raw milk and dairy products”, “Meat from bovine animals and sheep”, “Marine oil” and to 45-75 % of the sum for “Vegetable oils and fats”, “Hen eggs and eggs products” and “Meat poultry”. Up to 29 NDL-PCBs other than the six indicators were analysed in “Muscle meat from eels and other fishes”. They were found to represent a little more than 50 % of the sum of the measured NDL-PCB levels. The NDL-PCBs most frequently found at the highest level were PCB-110, PCB-99, PCB-187 and PCB-149.

These observations are in line with the previous conclusion from the EFSA CONTAM Panel that the sum of the six indicator PCBs represented about 50 % of the total NDL-PCBs in food (EFSA, 2005).

4.2.5.2. Relationship between the six NDL-PCB indicators and DL-PCBs

Results were available for both the six NDL-PCB indicators and DL-PCBs for 3,965 samples. A regression analysis was performed on the different food groups, and on all the feeds together. Detailed results are shown in Appendix D. The sum of the six NDL-PCB indicators was found to be positively correlated with the sum of DL-PCBs expressed in TEQ_{WHO05}. A relatively high correlation ($r > 0.6$) was found for feed, fats from pig and poultry, meat from fishes other than eels, liver from fish and hen eggs and egg products. Weak correlations were observed in some other food groups, especially in “Infant and baby foods”, “Raw milk and dairy products” and “Vegetable oils and fats” ($r \approx 0.1$). For some foods, especially fat and meat from ruminants, meat from pigs and the group of “other food products”, the correlations were strongly influenced by some outliers.

4.2.5.3. Special food groups

The distribution of contamination in the following special food groups as well as results of statistical tests applied between groups with more than 30 samples are presented in Table 17 for dioxins and DL-PCBs and in Table 18 for the six NDL-PCB indicators.

- ✓ Eggs

It was shown that eggs coming from battery rearing were significantly less contaminated by dioxins and DL-PCBs than those coming from free range, organic production and outdoor growing production, the eggs coming from free range being also significantly less contaminated than the two other farming systems. For the NDL-PCB indicators, due to the limited number of data, no comparison was made between eggs coming from battery rearing and the other groups. The eggs coming from outdoor growing condition appeared to be more contaminated at the upper bound estimate than eggs coming from organic production and free range.

- ✓ Milk and dairy products

A comparison of milk collected at different stages of the food chain revealed significantly higher levels of dioxins and DL-PCBs in milk from farms compared to milk from bulk, explained by the fact that the milk may not be pooled at this stage of the food chain. This was not the case when considering the six NDL-PCB indicators, where milk collected at the farm was on average less contaminated than milk from bulk or retail. The contamination of milk products (butter, cheese, other milk products) by dioxins and DL-PCBs was close to 1 pg TEQ_{WHO05}/g_{lw} on average and up to 4-5 pg TEQ_{WHO05}/g_{lw} at the 99^{th} percentile. Their contamination to six NDL-PCB indicators seemed to vary according to the kind of milk products, the butter being less contaminated than cheese.

- ✓ Meat from bovine animals and sheep

Meat from bovine animals was significantly more contaminated by dioxins and DL-PCBs, and by the six NDL-PCB indicators than meat from sheep.

- ✓ Fish meat

Farmed salmon and trout were significantly less contaminated than wild caught salmon and trout for both dioxins and DL-PCBs, and the six NDL-PCB indicators.

By way of derogation from Article 1 in Commission Regulation (EC) No 1881/2006, Finland and Sweden may authorise the placing on their market of wild caught salmon, herring, char, river lamprey and trout originating in the Baltic region and intended for consumption in their territory with levels of dioxins and/or levels of the sum of dioxins and DL-PCBs higher than those set out in the legislation. In a similar manner, Latvia may also authorise the placing on its market of wild caught salmon. Comparisons were made according to the countries of collection for herring, and salmon and trout. Not enough and/or sufficiently detailed data were available to include lamprey and char in the analysis. Two groups of countries were distinguished: “Baltic countries” including Sweden, Finland, Estonia, Latvia, Lithuania and Poland, and other countries (Denmark and Germany were included in the non Baltic region but it is acknowledged that these countries straddle the two areas). Table 19 illustrates the distribution of contamination. Herring, salmon and trout coming from the Baltic region were significantly more contaminated by dioxins and DL-PCBs and by the six NDL-PCB indicators than the ones coming from other regions.

Table 17: Distribution of the sum of dioxins and DL-PCBs levels expressed in pg TEQ_{WHO05}/g in focus food groups.

Food / Feed group	ER	N[(a)]	LC[(b)]	Lower bound estimate Mean [(c)]	Lower bound P50[(d)]	Lower bound P95[(d)]	Lower bound P99[(d)]	Upper bound estimate Mean[(c)]	Upper bound P50[(d)]	Upper bound P95[(d)]	Upper bound P99[(d)]	Dif[(e)]
Eggs												
- Battery eggs[1]	lw	30	0	0.18	0.04	0.80	1.87	0.25	0.07	0.92	2.13	2, 3, 4
- Free range[2]	lw	89	0	0.69	0.23	3.20	8.91	0.79	0.32	3.54	8.94	1, 3, 4
- Organic production[3]	lw	91	0	1.68	1.02	5.04	11.74	1.73	1.08	5.04	11.84	1, 2
- Outdoor growing condition[4]	lw	61	0	1.77	0.67	5.08	18.15	1.83	0.68	5.13	18.15	1, 2
- Egg not specified	lw	883	1	1.65	0.51	5.35	13.73	1.72	0.61	5.35	13.73	
Meat from bovine animals and sheep												
- Bovine[1]	lw	286	0	2.25	1.55	5.67	14.61	2.34	1.68	5.97	14.71	2
- Sheep[2]	lw	126	0	1.17	0.75	3.17	5.97	1.24	0.84	3.18	6.00	1
Fish meat, eels excluded												
- Wild caught char	ww	4	0	0.39	0.39	0.45	0.45	0.53	0.49	0.66	0.66	
- Wild caught herring	ww	659	0	4.80	2.96	14.98	21.69	4.81	3.02	14.98	21.69	
- Wild caught salmon and trout[1]	ww	388	0.5	3.90	1.37	11.97	19.42	3.92	1.42	11.97	19.42	2
- Wild caught freshwater fish	ww	330	0.3	2.76	0.76	10.41	32.03	2.78	0.81	10.45	32.04	
- Other wild caught fish	ww	1,356	1.0	1.76	0.72	5.95	11.80	1.78	0.74	6.00	11.81	
- Farmed salmon and trout[2]	ww	379	0	1.04	0.92	1.98	2.22	1.05	0.94	2.01	2.22	1
- Other farmed fish	ww	111	1.8	6.43	2.60	15.39	48.55	6.45	2.60	15.40	48.56	
- Seafood	ww	419	2.1	0.81	0.17	2.05	18.21	0.82	0.19	2.06	18.22	
- Fish products	ww	175	0	0.48	0.19	1.50	2.65	0.49	0.19	1.50	2.65	
Milk and dairy products												
- Milk from bulk[1]	fw	114	0	0.98	0.96	1.97	2.55	1.10	1.04	2.11	2.68	2
- Milk from farm[2]	fw	205	0	0.92	0.50	3.10	6.10	1.00	0.58	3.23	6.10	1
- Milk from retail	fw	12	0	0.91	0.73	2.08	2.08	1.12	0.96	2.47	2.47	
- Milk not specified	fw	393	3.3	4.20	1.03	7.79	19.37	4.33	1.14	8.02	19.39	
- Butter	fw	90	0	0.75	0.62	1.64	4.34	0.85	0.68	1.85	5.01	
- Cheese	fw	90	0	1.00	0.69	2.82	4.64	1.10	0.75	2.91	4.64	
- Other milk products	fw	518	1.2	0.87	0.70	1.98	4.21	0.95	0.74	2.02	4.28	

(a): number of samples. (b): percentage of left-censored results. (c): mean contamination. (d): P50, P95, P99: 50[th], 95[th] and 99[th] percentiles of contamination. (e): mentions the groups, as numbered in the column "Food / Feed group", for which the distribution of contamination differs significantly ($\alpha = 0.05$) from the corresponding group, applying the t test when the comparison is made between two groups, Bonferroni adjustments in case of a comparison between three and more groups. For example, the contamination level of free range eggs differs significantly at the lower and upper bounds from the contamination level of 1: battery eggs, 3: organic production and 4: eggs coming from outdoor growing condition. **Reminder: in case of too few observations (less than 60 observations for the 95th percentile and less than 300 observations for the 99th percentile), the estimation of high percentiles may be biased and must consequently be interpreted cautiously.**

Table 18: Distribution of the sum of the six NDL-PCB indicators levels expressed in µg/kg in focus food groups.

Food / Feed group	ER	N(a)	LC(b)	Lower bound estimate				Upper bound estimate				Dif(e)
				Mean(c)	P50(d)	P95(d)	P99(d)	Mean(c)	P50(d)	P95(d)	P99(d)	
Eggs												
- Battery eggs	lw	18	16.7	0.90	0.52	3.56	3.56	2.29	0.78	13.79	13.79	
- Free range[1]		49	14.3	7.90	1.75	32.60	104.00	9.75	2.75	32.60	104.00	3*
- Organic production[2]		77	19.5	4.36	3.75	11.59	25.27	7.56	5.01	14.94	32.97	3*
- Outdoor growing condition[3]		33	78.8	2.03	0.00	17.65	33.33	14.21	12.87	27.45	45.24	1*, 2*
- Egg not specified		838	10.4	12.36	2.35	64.00	134.00	12.99	2.65	64.30	134.00	
Meat from bovine animals and sheep												
- Bovine[1]	lw	271	14	9.55	6.23	28.30	66.03	11.00	6.52	31.20	69.83	2
- Sheep[2]		80	26.3	4.49	1.92	19.50	38.00	5.31	2.35	21.25	43.00	1
Fish meat, eels excluded												
- Wild caught char	ww	10	10.0	3.90	3.17	8.60	8.60	4.41	3.43	8.90	8.90	
- Wild caught herring		890	12.9	20.29	13.67	72.24	114.39	20.89	14.13	72.24	114.39	
- Wild caught salmon and trout[1]		704	22.4	16.74	2.86	66.87	122.01	17.31	3.71	66.87	122.01	2
- Wild caught freshwater fish		482	16.4	17.79	3.60	85.36	192.20	18.43	4.76	85.36	192.20	
- Other wild caught fish		1,993	26.2	18.79	2.20	99.07	301.92	19.42	3.46	101.53	302.62	
- Farmed salmon and trout[2]		525	56.6	3.64	0.00	15.18	21.40	4.72	2.70	15.18	21.53	1
- Other farmed fish		96	14.6	7.94	6.70	21.27	37.50	8.27	6.85	21.27	37.50	
- Seafood		498	15.5	1.60	0.32	7.56	16.56	1.84	0.62	7.57	16.56	
- Fish products		169	3.0	2.62	1.11	9.16	14.58	2.63	1.12	9.16	14.58	
- Wild caught char		10	10.0	3.90	3.17	8.60	8.60	4.41	3.43	8.90	8.90	
Milk and dairy products												
- Milk from bulk[1]	lw	2,861	1.3	9.52	9.25	16.03	19.99	9.76	9.41	16.12	19.99	2, 3
- Milk from farm[2]		281	23.1	1.63	1.29	4.01	12.00	6.70	2.62	16.00	20.00	1, 3
- Milk from retail[3]		40	12.5	5.53	5.68	12.45	14.96	7.82	6.31	17.12	17.24	1, 2
- Milk not specified		2164	2.9	9.13	9.10	15.61	23.43	9.23	9.15	15.80	23.80	
- Butter		93	0	2.84	2.22	5.69	18.65	3.09	2.22	7.50	18.65	
- Cheese		77	9.1	4.28	2.41	14.20	38.44	4.80	2.62	15.20	43.13	
- Other milk products		530	1.3	6.88	6.59	14.53	20.36	6.99	6.74	15.02	20.36	

(a): number of samples. (b): percentage of left-censored results. (c): mean contamination. (d): P50, P95, P99: 50th, 95th and 99th percentiles of contamination. (e): mentions the groups, as numbered in the column "Food / Feed group", for which the distribution of contamination differs significantly ($\alpha = 0.05$) from the corresponding group, applying the t test when the comparison is made between two groups, Bonferroni adjustments in case of a comparison between three and more groups. * applies for the upper bound estimate only. For example, the contamination level of free range eggs differs significantly at the upper bound from the contamination level of 3: eggs coming from outdoor growing condition. **Reminder: in case of too few observations (less than 60 observations for the 95th percentile and less than 300 observations for the 99th percentile), the estimation of high percentiles may be biased and must consequently be interpreted cautiously.**

Table 19: Distribution of the levels of dioxins and DL-PCBs and of the six NDL-PCB indicators between fishes collected in "Baltic" vs. other EU countries

Food group	N[(a)]	LC[(b)]	Lower bound estimate				Upper bound estimate				Dif[(e)]
			Mean[(c)]	P50[(d)]	P95[(d)]	P99[(d)]	Mean[(c)]	P50[(d)]	P95[(d)]	P99[(d)]	
Dioxins and DL-PCBs in pg TEQ_{WHO05} / g											
Herring											
Baltic	489	0	5.79	3.65	16.10	23.40	5.80	3.72	16.10	23.40	*
Other	170	0	1.95	1.69	4.00	5.96	1.97	1.71	4.02	5.96	
Salmon and trout											
Baltic	154	0	7.75	7.28	16.07	21.87	7.77	7.29	16.08	21.87	*
Other	341	0.6	1.24	0.78	4.78	8.92	1.25	0.79	4.82	8.93	
NDL-PCB indicators in µg / kg											
Herring											
Baltic	477	0.8	27.18	18.05	80.06	123.04	27.19	18.05	80.06	123.04	*
Other	413	26.9	8.84	7.70	22.00	27.20	10.05	8.62	22.39	29.00	
Salmon and trout											
Baltic	208	2.9	42.13	40.93	103.93	135.69	42.15	40.93	103.93	135.69	*
Other	498	30.5	4.95	1.39	29.24	60.41	5.72	2.50	29.24	60.41	

(a): number of samples. (b): percentage of censored results. (c): mean contamination. (d): P50, P95, P99: 50th, 95th and 99th percentiles of contamination. (e): * indicates that the contamination levels of the two population groups differs significantly (α = 0.05) applying the t test. **Reminder: in case of too few observations (less than 60 observations for the 95th percentile and less than 300 observations for the 99th percentile), the estimation of high percentiles may be biased and must consequently be interpreted cautiously.**

4.3. Dietary exposure

4.3.1. Chronic exposure to the sum of dioxins and DL-PCBs

4.3.1.1. Food / food groups taken into account in the exposure assessment

The contamination data available for the period 2008-2010 allowed an estimation of contamination for 114 foods and food groups at different levels of the FoodEx1 hierarchy: 2 at level 4, 78 at level 3, 29 at level 2 and 5 at level 1. Eleven assumptions were made, as detailed in Appendix E.

Some food/food groups were insufficiently covered to be taken into account in the exposure assessment:

- beverages (alcoholic beverages, drinking water, fruits and vegetables juices, non-alcoholic beverages),
- products of plant origin (fruit and fruit products (four samples available), grain and grain-based products (three samples available), herbs, spices and condiments, legumes, nuts and oilseeds, starchy root and tubers (one sample available), vegetables and vegetable products (eleven samples available),
- processed foods: composite foods (two samples available), sugar and confectionary (except honey), snacks, desserts and other foods, meat specialities (one sample available), meat and milk products imitates,
- products for special nutritional uses, except mineral supplements, vitamin supplements and supplements containing special fatty acids,
- human milk and fruit juice and herbal tea for infants and young children,
- other foods: amphibians, reptiles, snails, insects, grey mullet, shark (selachoidei), smelt, fish roe and game birds.

4.3.1.2. Current exposure across the different population groups

As most of the samples considered for the exposure assessment were quantified, the lower and upper bound exposure estimates were identical. Table 20 presents upper bound estimates obtained across the different population groups for the most recent period, 2008-2010.

Toddlers and other children were the most exposed groups, with an average exposure for the sum of dioxins and DL-PCBs of between 1.08 and 2.54 pg TEQ_{WHO05}/kg b.w. per day and 95th percentile exposure between 2.6 and 9.9 pg TEQ_{WHO05}/kg b.w. per day. Consequently, depending on the population group, between 7 % and 52.9 % of the individuals would have an exposure higher than the TWI of 14 pg TEQ_{WHO05}/kg b.w., corresponding with a value of 2 pg TEQ_{WHO05}/kg b.w. per day.

These estimates are quite consistent with those reported in the literature (Appendix F). From monitoring and market basket data, exposure was estimated for Dutch, Swedish, Italian, French and Spanish toddlers and/or children to be on average between 2.3 and 4.58 pg $TEQ_{WHO98/05}$/kg b.w. per day and at the 95th percentile between 3.7 and 8.1 pg $TEQ_{WHO98/05}$/kg b.w. per day (Weijs *et al*., 2006, Bergkvist *et al*., 2008, Fattore *et al*., 2006, Tard *et al*., 2007, Marin *et al*., 2011). Nevertheless, lower exposure was reported from Total Diet Studies (TDS) in United Kingdom and France: on average 0.7 – 1.8 pg TEQ_{WHO98}/kg b.w. per day and 2.02 pg TEQ_{WHO98}/kg b.w. per day for the 95th percentile (FSA, 2003, Sirot *et al.,* 2012).

Table 20: Dietary exposure to the sum of dioxins and DL-PCBs estimated for the period 2008-2010 expressed in pg TEQ_{WHO05}/kg b.w. per day estimated across the different groups

Country	Survey acronym	N[(a)]	Mean[(b)]	P95[(c)]	Perc [IC_{95}][(d)]
		Infants			
Bulgaria	NUTRICHILD	860	1.17	3.0	16 [13.6; 18.5]
Italy	INRAN SCAI 2005 06	16	1.08	5.9	6.3 [0.2; 30.2]
		Toddlers			
Belgium	Regional Flanders	36	1.77	3.5	30.6 [16.4; 48.1]
Bulgaria	NUTRICHILD	428	2.53	5.8	53 [48.3; 57.8]
Finland	DIPP	497	2.54	8.0	38.8 [34.5; 43.1]
Germany	DONALD 2006	92	1.84	4.9	26.1 [17.5; 36.3]
Germany	DONALD 2007	85	1.54	3.3	17.6 [10.2; 27.4]
Germany	DONALD 2008	84	1.59	4.3	20.2 [12.2; 30.4]
Italy	INRAN SCAI 2005 06	36	2.34	5.1	44.4 [27.9; 61.9]
Netherlands	VCP kids	322	1.25	2.6	11.5 [8; 15]
Spain	enKid	17	2.44	9.9	52.9 [27.8; 77.0]
		Other children			
Belgium	Regional Flanders	625	1.52	4.8	18.9 [15.8; 21.9]
Bulgaria	NUTRICHILD	433	2.33	6.3	43.9 [39.2; 48.6]
Czech Republic	SISP04	389	2.27	8.1	28 [23.6; 32.5]
Denmark	Danish Dietary Survey	490	1.95	4.3	32.7 [28.5; 36.8]
Finland	DIPP	933	2.49	6.5	42.8 [39.6; 45.9]
Finland	STRIP	250	1.27	3.6	18.8 [14; 23.6]
France	INCA2	482	2.37	5.3	52.9 [48.4; 57.4]
Germany	DONALD 2006	211	1.32	3.5	12.3 [7.9; 16.8]
Germany	DONALD 2007	226	1.29	2.9	11.9 [7.7; 16.2]
Germany	DONALD 2008	223	1.39	3.8	13 [8.6; 17.4]
Greece	Regional Crete	839	1.23	4.5	16.7 [14.2; 19.2]
Italy	INRAN SCAI 2005 06	193	2.15	5.7	26.4 [20.2; 32.6]
Latvia	EFSA TEST	189	1.13	3.8	12.2 [7.5; 16.8]
Netherlands	VCP kids	957	1.08	2.2	7 [5.4; 8.6]
Spain	enKid	156	2.03	7.0	28.8 [21.7; 36]

Country	Survey acronym	N(a)	Mean(b)	P95(c)	Perc [IC_{95}](d)
Spain	NUT INK05	399	2.27	7.0	32.6 [28; 37.2]
Sweden	NFA	1,473	1.29	3.3	15.3 [13.4; 17.1]
		Adolescents			
Belgium	Diet National 2004	584	0.65	2.3	6 [4.1; 7.9]
Cyprus	Childhealth	303	0.78	2.9	12.2 [8.5; 15.9]
Czech Republic	SISP04	298	1.67	5.8	19.1 [14.7; 23.6]
Denmark	Danish Dietary Survey	479	1.06	2.3	7.9 [5.5; 10.4]
France	INCA2	973	1.26	3.0	15.2 [13; 17.5]
Germany	National Nutrition Survey II	1011	0.57	1.6	3.3 [2.2; 4.4]
Italy	INRAN SCAI 2005 06	247	1.36	4.3	15.4 [10.9; 19.9]
Latvia	EFSA TEST	470	0.73	2.0	5.3 [3.3; 7.3]
Spain	AESAN FIAB	86	1.27	3.3	14 [7.4; 23.1]
Spain	enKid	209	1.41	5.4	15.3 [10.4; 20.2]
Spain	NUT INK05	651	1.31	4.0	16.9 [14; 19.8]
Sweden	NFA	1,018	0.81	2.3	7.7 [6; 9.3]
		Adults			
Belgium	Diet National 2004	1,304	0.82	2.8	9.2 [7.6; 10.8]
Czech Republic	SISP04	1,666	1.11	3.9	13.6 [11.9; 15.2]
Denmark	Danish Dietary Survey	2,822	0.95	2.0	5 [4.2; 5.8]
Finland	FINDIET 2007	1,575	1.12	3.7	17.3 [15.5; 19.2]
France	INCA2	2,276	1.18	2.6	13 [11.6; 14.4]
Germany	National Nutrition Survey II	10,419	0.79	2.9	8.9 [8.3; 9.4]
Hungary	National Repr Surv	1074	0.77	1.9	4 [2.8; 5.2]
Ireland	NSIFCS	958	0.89	2.2	7.2 [5.6; 8.8]
Italy	INRAN SCAI 2005 06	2,313	1.21	4.2	16.5 [15; 18]
Latvia	EFSA TEST	1,306	0.86	3.1	11.5 [9.8; 13.2]
Netherlands	DNFCS 2003	750	0.57	1.4	2.3 [1.2; 3.3]
Spain	AESAN	410	1.33	4.5	14.9 [11.4; 18.3]
Spain	AESAN FIAB	981	1.64	4.4	26.2 [23.4; 28.9]
Sweden	Riksmaten 1997 98	1,210	0.92	2.3	7.3 [5.8; 8.7]
United Kingdom	NDNS	1,724	0.75	2.0	5.2 [4.1; 6.2]
		Elderly			
Belgium	Diet National 2004	518	0.99	3.6	12.5 [9.7; 15.4]
Denmark	Danish Dietary Survey	309	1.19	2.6	11.3 [7.8; 14.9]
Finland	FINDIET 2007	463	1.43	4.6	26.3 [22.3; 30.4]
France	INCA2	264	1.28	2.9	17 [12.5; 21.6]
Germany	National Nutrition Survey II	2,006	0.92	3.5	12.8 [11.3; 14.3]
Hungary	National Repr Surv	206	0.59	1.2	1 [0; 2.3]
Italy	INRAN SCAI 2005 06	290	1.07	3.6	14.1 [10.1; 18.1]
		Very elderly			
Belgium	Diet National 2004	712	0.95	3.5	12.1 [9.7; 14.5]
Denmark	Danish Dietary Survey	20	1.49	4.0	15 [3.2; 37.9]
France	INCA2	84	1.20	2.8	14.3 [7.6; 23.6]
Germany	National Nutrition Survey II	490	1.01	3.8	13.9 [10.8; 16.9]
Hungary	National Repr Surv	80	0.61	1.2	1.3 [0.03; 6.8]
Italy	INRAN SCAI 2005 06	228	0.77	2.5	7.5 [4; 10.9]

(a): number of subjects. (b): mean exposure. (c): P95: 95th percentiles of exposure. (d): percentage of individuals with an exposure above the TWI with its corresponding 95% confidence interval. **Reminder: in case of too few observations (less than 60 observations for the 95th percentile), the estimation of high percentiles may be biased and must consequently be interpreted cautiously.**

Adolescents, adults, elderly and very elderly had lower dietary exposure compared to toddlers and other children, with an average exposure of between 0.57 and 1.67 pg TEQ_{WHO05}/kg b.w. per day and a 95th percentile of exposure between 1.2 and 5.8 pg TEQ_{WHO05}/kg b.w. per day. The percentage of individuals with dietary exposure above the TWI was estimated to be between 1.0 % and 26.2 % depending on the population group.

Once again, these estimates are quite consistent with those estimated from monitoring and market basket surveys at the national level in Sweden, Italy, Spain, Finland, France and Netherlands: between 0.6 and 2.86 pg $TEQ_{WHO98/05}$/kg b.w. per day on average and 1.28 and 5.1 pg $TEQ_{WHO98/05}$/kg b.w. per day for the 95th percentile (Bergkvist *et al*., 2008, Fattore *et al*., 2006, Perello *et al.*, 2012, Kiviranta *et al*., 2004, Tard *et al*., 2007, Marin *et al*., 2011, De Mul *et al*., 2008, Törnkvist *et al.,* 2011). Two recent TDS surveys conducted in Belgium (Windal *et al*., 2010) and France (Sirot *et al.,* 2012) provide refined estimates, with an average exposure between 0.57-0.61 pg $TEQ_{WHO98/05}$/kg b.w. per day and a 95th percentile of 1.29 pg TEQ_{WHO98}/kg b.w. per day.

Infants were found to be less exposed than toddlers and other children, with an average exposure around 1.1 pg TEQ_{WHO05}/kg b.w. per day. However, it should be noted that since human milk was not taken into account in this assessment, their true dietary exposure is underestimated.

4.3.1.3. Foods contributing to the current dietary exposure

✓ *Relative contribution to total exposure*

The relative contribution of the seven main food groups taken into account in the exposure assessment (fish and seafood products, milk and dairy products, meat and meat products, egg and egg products, oils and fats from animal and plant origin, foods for infants and young children, other foods (dietary supplements and honey) are detailed in Appendix G.

In almost all adolescents, adults, elderly and very elderly population groups (34/40), fish and seafood products was the food group (30.2-75.0 %) contributing most to total exposure. It was followed either by meat and meat products (8.8-34.4 %) or milk and dairy products (7.3-24.6 %). Six population groups – Hungarian adults, elderly and very elderly, Dutch adults, Latvian and German adolescents – had a different profile of exposure with meat and meat products being the highest contributing group to their exposure (35.4-37.7 %).

In most infant and toddler population groups across Europe, the major contributor to total exposure was milk and dairy products (27.5-49.6 %). In infants, it was followed by foods for infants and young children (21.7-30.9 %) and in toddlers by either fish and seafood products (10.7-35.8 %) or by meat and meat products (10.4-33.7 %).

Depending on the country, other children population groups had an exposure profile close to one of the profiles previously described:

- Milk and dairy products as major contributor, as observed in infant and toddlers, for Belgian and Dutch children,
- Meat and meat products as major contributor, as observed in German adolescents, for German and Bulgarian children,
- Fish and seafood products as major contributor, as observed in most adults groups, for the other children in Sweden, Finland, Latvia, Denmark, France, Greece, Italy, Spain and Czech Republic.

✓ *Main contributors to the TWI*

The detailed foods contributing more than 10 % to the TWI were identified for each population group, considering all the individuals and the 5 % most exposed individuals (Table 21). When considering all individuals, 17 food/food groups were identified as main contributors in at least one population group.

They mostly corresponded to fish and seafood products (N=8), milk and dairy products (N=5) and meat and meat product (N = 3). The three foods most frequently identified as main contributors were "Herring", "Salmon and trout" and "Cow milk". When considering the 5 % most exposed individuals, 19 additional food/food groups contributed to more than 10 % of the TWI.

Table 21: Food contributing to more than 10% of the TWI

Food description	All individuals[(a)]		5 % most exposed[(a)]	
	N[(b)]	Contribution range[(c)]	N[(b)]	Contribution range[(c)]
Animal and vegetables fats and oils				
Butter	5	11.4 - 17.1	8	10.1 - 31.1
Olive oil	-	-	1	15.1
Fish and seafood products				
Anchovy	1	13.0	12	16.3 - 175.6
Bream	2	10.1 - 19.5	9	10.9 - 358.4
Cod and whiting	1	10.8	-	-
Carps	-	-	4	10.4 - 14.7
Eels	1	11.6	15	13.4 - 73.9
Flounder	-	-	1	56.6
Herring	7	10.1 - 21.0	33	12.8 - 147.9
Mackerel	-	-	5	14.6 - 36.2
Perch	-	-	2	17.5 - 31.3
Salmon and trout	8	10.7 - 29.0	55	11.5 - 236.1
Sardine and pilchard	-	-	5	10.0 - 65.9
Sprat	-	-	4	11.8 - 46.3
Tuna	-	-	6	10.5 - 40.0
Whitefish	-	-	4	11.2 - 112.6
Fish meat not specified	28	10.1-42.9	54	13.9 - 425.1
Fish offals (roe excluded)	-	-	5	11.7 - 55.5
Mussel	-	-	1	16.6
Squid	-	-	1	10.1
Unspecified water molluscs	-	-	1	64.1
Unspecified fish and seafood products	1	12.3	8	14.3 - 98.4
Food for infants and young children				
Ready-to-eat meal for children, meat/fish-based	1	10.6	-	-
Meat and meat products				
Beef meat	4	10.2 - 16.4	6	11.6 - 28.3
Mutton / lamb meat	-	-	1	10.5
Mixed beef and pork meat	2	11.9 - 12.7	2	15.2 - 28.8
Goose meat	-	-	1	10.5
Sausages	2	10.4 - 16.8	6	11.0 - 33.3
Unspecified meat products	-	-	2	11.7 21.0
Milk and dairy products				
Cheese	2	10.2 - 17.2	9	10.1 - 23.0
Cream	-	-	1	10.0
Yoghurt, cow milk, plain	-	-	1	12.7
Cow milk	7	10.2 - 19.6	7	10.1 - 20.8
Goat milk	-	-	2	10.3 - 47.9
Liquid milk unspecified	1	10.6	1	10.91
Milk and dairy product unspecified	1	24.3	1	413

(a): all individuals: determination of the food contributing to more than 10% of the TWI considering all the individuals, 5% most exposed: considering only the 5% most exposed individuals in each population group. (b): number of population groups for which the food contribute to more than 10% of the TWI. (c): contribution range is defined as minimum and maximum contribution observed among these population groups, expressed in % of the TWI.

However, it should be pointed out that due to the few data available for “Butter”, “Anchovy”, “Carp”, “Flounder” and “Tuna”, contamination levels attributed to these foods were calculated from their broader food group. Also, the contamination level of “Fish offals other than roe”, “Mixed meat”, “Goose meat”, “Cream”, “Yoghurt cow milk, plain” and “Goat milk” were estimated from a small dataset. As a consequence, the estimation of their contamination level may be biased.

4.3.1.4. Changes in dietary exposure over time

Figures 9 – 13 represent changes in the average exposure (middle bound estimate) to dioxins and DL-PCBs estimated for each population group between 2002 and 2010. For all groups, a decrease was observed between 2002-2004 and 2008-2010, which was statistically significant (α = 0.05). Depending on the population group, the decrease was estimated to be between 16.6 % and 79.3 %. In a few population groups, an increase was observed between 2002-2004 and 2005-2007, mainly explained by the specific contribution of cow milk and yoghurt for which the contamination levels were estimated to be respectively 4 and 10 times higher between 2005-2007 than between 2002-2004. A detailed look at the data available for milk and yoghurt revealed the presence of some very high values coming from Belgium for the year 2007, which may not be representative of the background level of contamination of such products.

It should be noted that the exposure estimates don’t take into account possible changes in food consumption habits of the different population groups over time, but only changes in occurrence levels.

In order to compare the results, the dietary exposure for the 2002-2004 and 2005-2007 periods was estimated considering the same foods as for which data were available for the period 2008-2010, with more or less the same level of aggregation of the data. As a consequence, data available for other foods were not taken into account.

Nevertheless, a similar decrease can also be observed in the recent literature. Windal *et al*. (2010) reports a 60-70 % decrease in exposure of the Belgium population between 2001 and 2008. Perello *et al*. (2012) mentions a decrease of 83 % in exposure of the Catalonian population between 2000 and 2008.

Such observed decreases might be attributable to the effects of the European risk management measures to reduce the exposure of the European population, but could also in part be due to improvements of the analytical methods and sampling designs of the monitoring programs over the years.

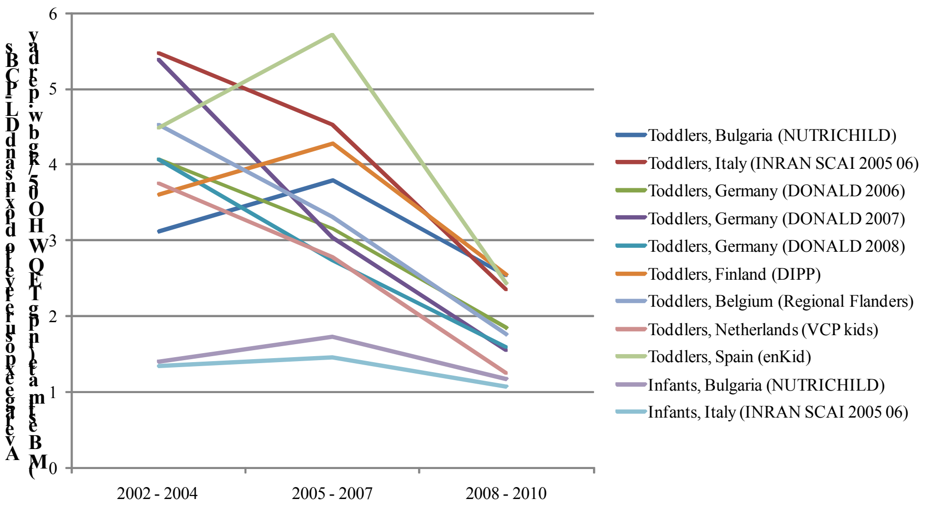

Figure 9: Average exposure of European infants and toddlers to the sum of dioxins and DL-PCBs.

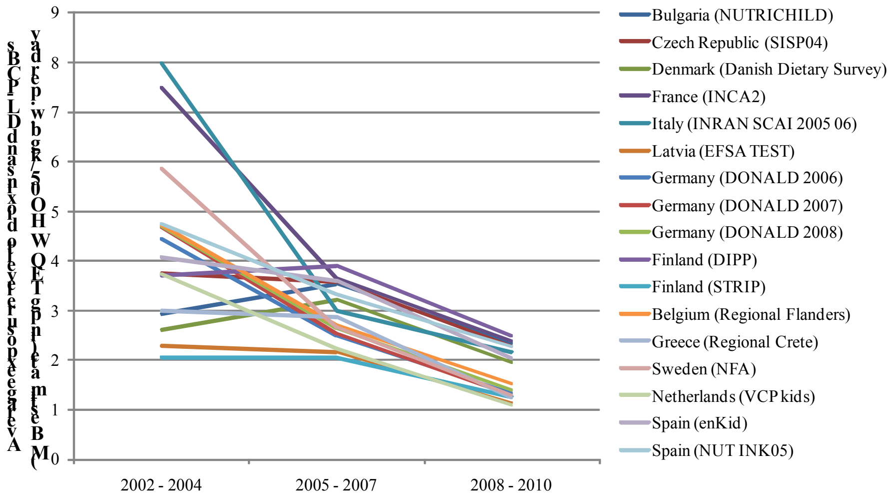

Figure 10: Average exposure of European other children to the sum of dioxins and DL-PCBs.

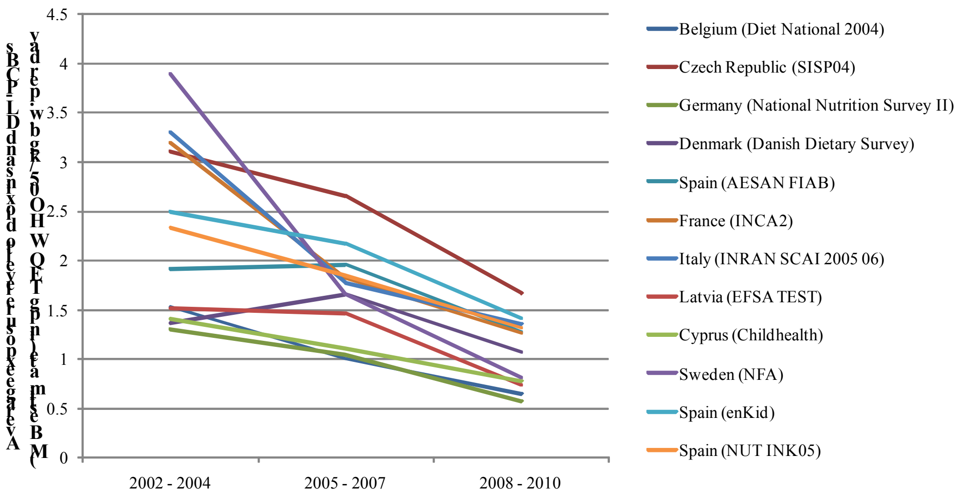

Figure 11: Average exposure of European adolescents to the sum of dioxins and DL-PCBs.

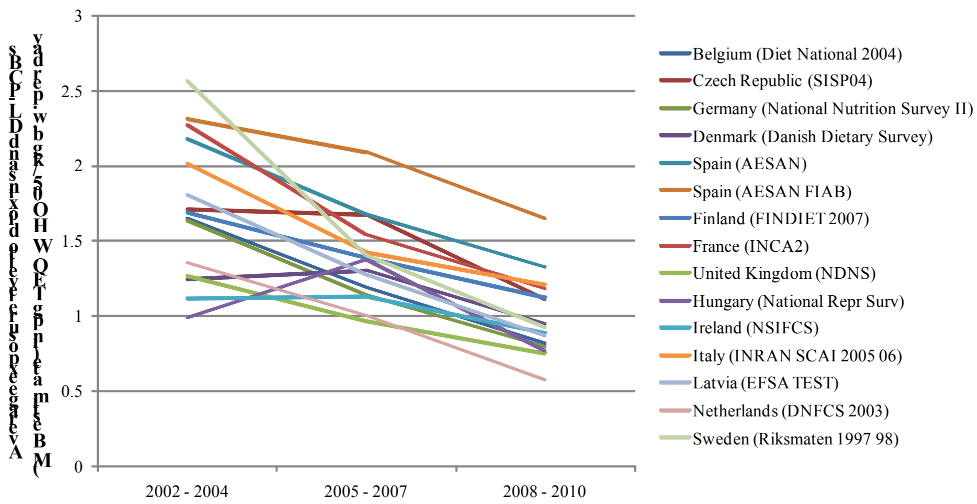

Figure 12: Average exposure of European adults to the sum of dioxins and DL-PCBs.

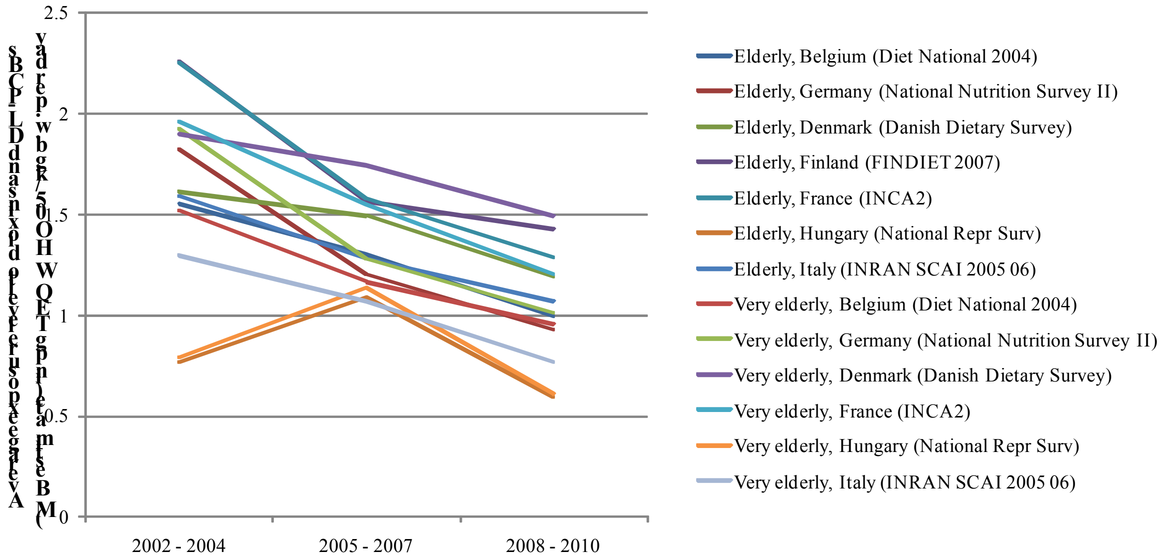

Figure 13: Average exposure of European elderly and very elderly to the sum of dioxins and DL-PCBs.

4.3.2. Chronic exposure to the sum of the six NDL-PCB indicators

4.3.2.1. Food / food groups taken into account in the exposure assessment

The contamination data available for the period 2008-2010 allowed an estimation of the contamination levels for 100 food and food groups at the different levels of the FoodEx1 hierarchy: 3 at level 4, 68 at level 3, 24 at level 2 and 5 at level 1. Nine assumptions were made, as detailed in Appendix E.

Some food/food groups were insufficiently documented to be taken into account in the exposure assessment:

- beverages (alcoholic beverages (14 samples available), drinking water (2 samples available), fruits and vegetables juices (22 samples available), non-alcoholic beverages (2 samples available),
- products of plant origin (fruit and fruit products (22 samples available), grain and grain-based products (27 samples), herbs, spices and condiments (3 samples available), legumes, nuts and oilseeds (6 samples available), starchy root and tubers (6 sample available), vegetables and vegetable products (41 samples available),
- processed foods: composite foods (8 samples available), sugar and confectionary (excepted honey) (4 samples available), snacks, desserts and other foods (5 samples available), meat and milk products imitates, milk based beverages, milk derivatives, whey and whey products.
- products for special nutritional uses, excepted mineral supplements, vitamin supplements and supplements containing special fatty acids,
- human milk and fruit juice and herbal tea for infants and young children,
- other foods: frog legs, grey mullet, shark (selachoidei), smelt and game birds.

4.3.2.2. Current exposure across the different population groups

Table 22 presents the lower bound and upper bound exposure estimates obtained across the different population groups for the most recent period, 2008-2010. Except for Bulgarian toddlers and other children, the lower bound and upper bound estimates were rather close. As a consequence, only the upper bound values will be further discussed.

Table 22: Dietary exposure to the sum of the six NDL-PCBs indicators for the period 2008-2010 expressed in ng/kg b.w. per day estimated across the different population groups

Country	Survey acronym	N[(a)]	Lower bound		Upper bound	
			Mean[(b)]	P95[(c)]	Mean[(b)]	P95[(c)]
Infants						
Bulgaria	NUTRICHILD	860	7.2	17.7	11.0	35.4
Italy	INRAN SCAI 2005 06	16	8.3	31.7	8.5	35.4
Toddlers						
Belgium	Regional Flanders	36	10.8	20.0	11.8	23.5
Bulgaria	NUTRICHILD	428	12.8	33.2	23.0	53.5
Finland	DIPP	497	13.6	41.0	15.9	46.1
Germany	DONALD 2006	92	12.5	27.9	13.5	29.3
Germany	DONALD 2007	85	11.4	26.1	12.3	27.2
Germany	DONALD 2008	84	11.2	23.4	11.8	23.4
Italy	INRAN SCAI 2005 06	36	16.9	36.6	19.2	39.8
Netherlands	VCP kids	322	8.3	18.2	8.8	20.5
Spain	enKid	17	18.9	52.7	25.7	52.7
Other children						
Belgium	Regional Flanders	625	9.3	24.4	10.2	26.9
Bulgaria	NUTRICHILD	433	11.3	36.7	19.6	50.6
Czech Republic	SISP04	389	12.4	41.7	15.5	44.7
Denmark	Danish Dietary Survey	490	10.8	24.3	12.8	26.7
Finland	DIPP	933	13.5	33.8	15.6	37.0
Finland	STRIP	250	7.4	19.9	8.2	21.7
France	INCA2	482	14.7	31.6	17.1	33.6
Germany	DONALD 2006	211	8.4	19.2	9.3	21.5
Germany	DONALD 2007	226	8.2	17.4	9.3	19.2
Germany	DONALD 2008	223	8.8	19.2	9.7	23.2
Greece	Regional Crete	839	8.4	22.7	9.6	24.1
Italy	INRAN SCAI 2005 06	193	16.1	45.4	18.8	47.2
Latvia	EFSA TEST	189	6.2	17.0	8.1	22.8
Netherlands	VCP kids	957	7.3	16.6	7.8	16.7
Spain	enKid	156	13.7	38.5	18.1	42.6
Spain	NUT INK05	399	15.0	38.8	18.5	42.1
Sweden	NFA	1,473	9.2	20.9	10.3	22.7
Adolescents						
Belgium	Diet National 2004	584	3.7	12.4	4.5	13.1
Cyprus	Childhealth	303	4.7	15.9	5.9	17.1
Czech Republic	SISP04	298	9.3	29.2	11.0	30.8
Denmark	Danish Dietary Survey	479	6.0	11.8	7.2	14.9
France	INCA2	973	7.4	16.7	8.8	18.2
Germany	National Nutrition Survey II	1,011	3.3	8.5	4.3	11.3

Country	Survey acronym	N[(a)]	Lower bound		Upper bound	
			Mean[(b)]	P95[(c)]	Mean[(b)]	P95[(c)]
Italy	INRAN SCAI 2005 06	247	9.0	36.4	10.3	36.4
Latvia	EFSA TEST	470	4.0	11.2	5.5	14.2
Spain	AESAN FIAB	86	7.7	18.9	9.9	22.4
Spain	enKid	209	9.8	25.7	12.5	28.4
Spain	NUT INK05	651	8.3	22.5	10.3	25.1
Sweden	NFA	1,018	5.6	14.2	6.4	15.1
Adults						
Belgium	Diet National 2004	1,304	4.6	14.7	5.4	15.3
Czech Republic	SISP04	1,666	6.2	19.7	7.4	21.3
Denmark	Danish Dietary Survey	2,822	5.4	10.8	6.3	11.8
Finland	FINDIET 2007	1,575	6.1	18.6	6.9	19.7
France	INCA2	2,276	6.7	14.3	8.0	15.9
Germany	National Nutrition Survey II	10,419	4.3	14.4	5.3	15.9
Hungary	National Repr Surv	1,074	4.1	9.5	5.6	11.8
Ireland	NSIFCS	958	4.8	10.9	6.7	13.5
Italy	INRAN SCAI 2005 06	2,313	7.8	31.9	8.7	33.0
Latvia	EFSA TEST	1,306	4.6	16.0	5.9	17.6
Netherlands	DNFCS 2003	750	3.8	8.1	4.5	9.5
Spain	AESAN	410	8.0	21.0	9.6	25.0
Spain	AESAN FIAB	981	9.5	24.2	11.5	26.7
Sweden	Riksmaten 1997 98	1,210	5.7	12.8	6.0	13.1
United Kingdom	NDNS	1,724	4.1	9.8	5.3	11.7
Elderly						
Belgium	Diet National 2004	518	6.0	17.4	6.6	17.4
Denmark	Danish Dietary Survey	309	6.9	14.2	7.7	15.9
Finland	FINDIET 2007	463	7.5	23.0	8.1	23.2
France	INCA2	264	7.3	16.5	8.4	18.1
Germany	National Nutrition Survey II	2,006	5.1	17.3	5.9	18.3
Hungary	National Repr Surv	206	3.3	6.4	4.5	9.5
Italy	INRAN SCAI 2005 06	290	6.7	26.3	7.7	28.0
Very elderly						
Belgium	Diet National 2004	712	5.9	17.3	6.5	17.3
Denmark	Danish Dietary Survey	20	9.5	36.0	10.3	36.5
France	INCA2	84	6.7	14.5	7.7	15.7
Germany	National Nutrition Survey II	490	5.4	17.7	6.2	18.6
Hungary	National Repr Surv	80	3.5	5.6	4.4	7.8
Italy	INRAN SCAI 2005 06	228	4.7	13.2	5.6	13.5

(a): number of subjects. (b): mean exposure. (d): P95: 95th percentiles of exposure. (e): percentage of individuals with an exposure above the TWI with its corresponding 95% confidence interval. **Reminder: in case of too few observations (less than 60 observations for the 95th percentile), the estimation of high percentiles may be biased and must consequently be interpreted cautiously.**

As observed for dioxins and DL-PCBs, infants, toddlers and other children were the most exposed population groups, with average exposures between 7.8 and 25.7 ng/kg b.w. per day and 95th percentile exposures between 16.7 and 53.7 ng/kg b.w. per day.

These levels are in the range of those reported from exposure studies between 1994 and 2004, with averages between 13.5 and 25 ng/kg b.w. per day for the sum of the 6 indicator PCBs, as referenced in the opinion of the CONTAM Panel on NDL-PCBs (EFSA, 2005). The recent literature on exposure of the European population to NDL-PCBs (Appendix F) is less extensive than for dioxins and DL-PCBs.

From monitoring data, exposure to the sum of the six indicators was estimated for Italian and French toddlers and/or children to be on average between 12.9 and 24.6 ng/kg b.w. per day and at the 95th percentile between 27.3 and 60.0 ng/kg b.w. per day (Fattore *et al*., 2008, Arnich *et al*., 2009), which was quite consistent with the levels estimated in this report. The recent French TDS provides refined estimates for French children with an average and a 95th percentile of respectively 3.77 and 11.7 ng/kg b.w. per day for the sum of the six indicators (Sirot *et al.,* 2012).

Adolescents, adults, elderly and very elderly were less exposed than infants, toddlers and other children, with an average exposure between 4.3 and 12.5 ng/kg b.w. per day and a 95th percentile of exposure between 7.8 and 36.5 ng/kg b.w. per day.

These levels correspond to the lowest levels reported in the previous EFSA opinion, which ranged between 4.8 and 18 ng/kg b.w. per day for the sum of the six NDL-PCB indicators (EFSA, 2005). They are also consistent with later estimates from monitoring data at the national level in Italy, France and Slovak Republic of between 7.7 and 17.0 ng/kg b.w. per day on average and between 16.0 and 45.0 ng/kg b.w. per day for the 95th percentile (Fattore *et al*., 2008, Arnich *et al*., 2009, Salgovicova *et al*., 2007). Exposure to the sum of the 6 NDL-PCB indicators was estimated from refined surveys (duplicate diets, TDS) at 2.71 ng/kg b.w. per day on average and 7.90 ng/kg b.w. per day at the 95th percentile for the French adult population (Sirot *et al.,* 2012) and at 2.8 ng/kg b.w. per day as a median for a German adult group (Fromme *et al*., 2009).

4.3.2.3. Contributing foods to current dietary exposure

The relative contribution of the seven main food groups taken into account in the exposure assessment (fish and seafood products, milk and dairy products, meat and meat products, egg and eggs products, oils and fats from animal and plant origin, foods for infants and young children, other foods (dietary supplements and honey) are detailed in Appendix G.

The profiles of exposure of adolescents, adults, elderly and very elderly showed more variation than for dioxins and DL-PCBs. In 2/3 of the population groups, as for dioxins and DL-PCBs, fish and seafood products was the food group contributing most to total exposure (35.9-65.4 %), followed by meat and meat products (17.1 – 40.9 %). In nine other population groups, meat and meat products was the first contributor followed by fish and seafood products. As observed for dioxins and DL-PCBs, six population groups – Hungarian adults, elderly and very elderly, Dutch adults, Latvian and German adolescents – had a different profile of exposure, with meat and meat products still being the major contributing group (43.1-57.6 %), followed by milk and dairy products (16.3-23.6 %).

In seven groups of infants, toddlers or other children, milk and dairy products (28.4-43.5 %) or foods for infants and young children (0.23-39.01 %) were the major contributors to total exposure, followed by fish and seafood products (17.3-30.0 %) or by meat and meat products (5.3 – 27.3 %). The other groups generally showed the same pattern of exposure as adolescents or adults of the same country.

4.3.2.4. Changes in dietary exposure over time

Figure 14 – 18 represent changes in the average exposure (upper bound estimate) to the sum of the six NDL-PCB indicators estimated for each population group. For almost all groups (61/68), a decrease was observed between 2002-2004 and 2008-2010. Nevertheless, it was overall less than what was observed for dioxins and DL-PCBs, at between 2.0 % and 75.6 %, and not always statistically significant. It seemed that the exposure decreased between 2002-2004 and 2005-2007, and then stagnated or even slightly increased between 2005-2007 and 2008-2010.

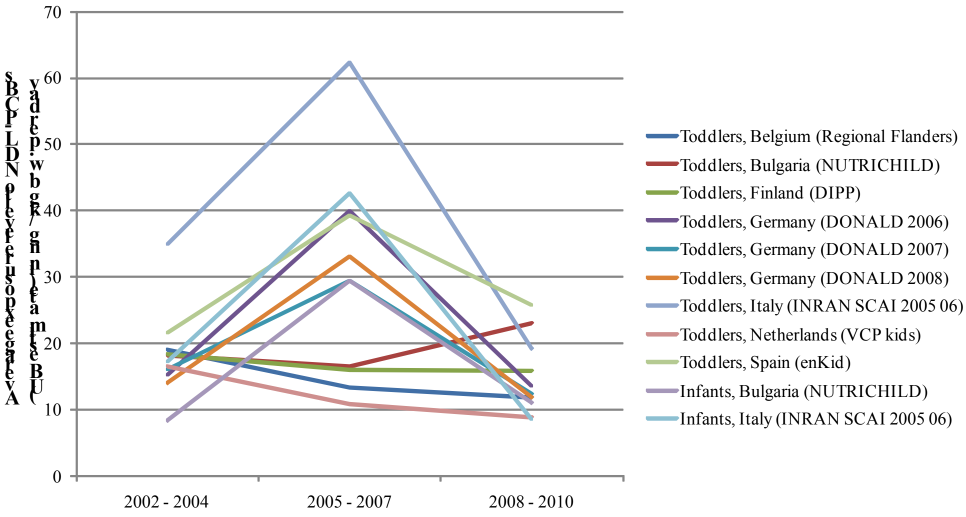

Figure 14: Average exposure of European infants and toddlers to the sum of the 6 NDL-PCB indicators.

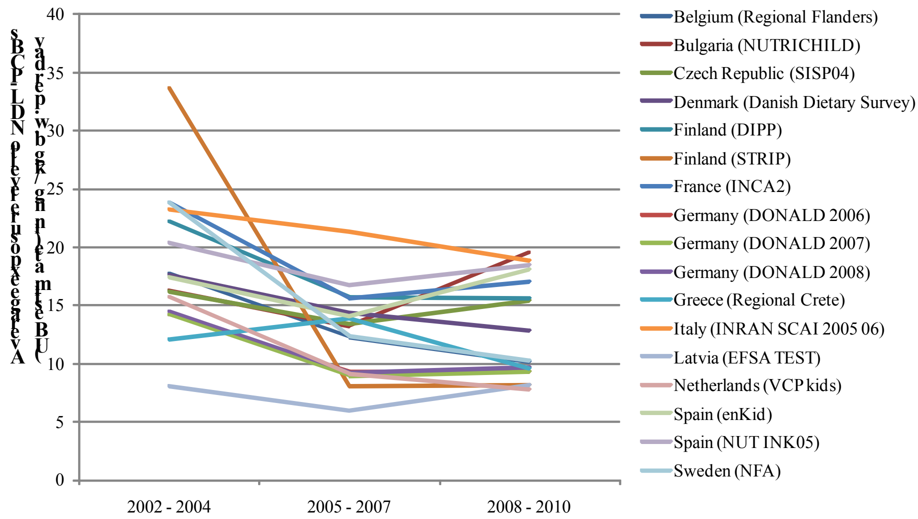

Figure 15: Average exposure of European other children to the sum of the 6 NDL-PCB indicators.

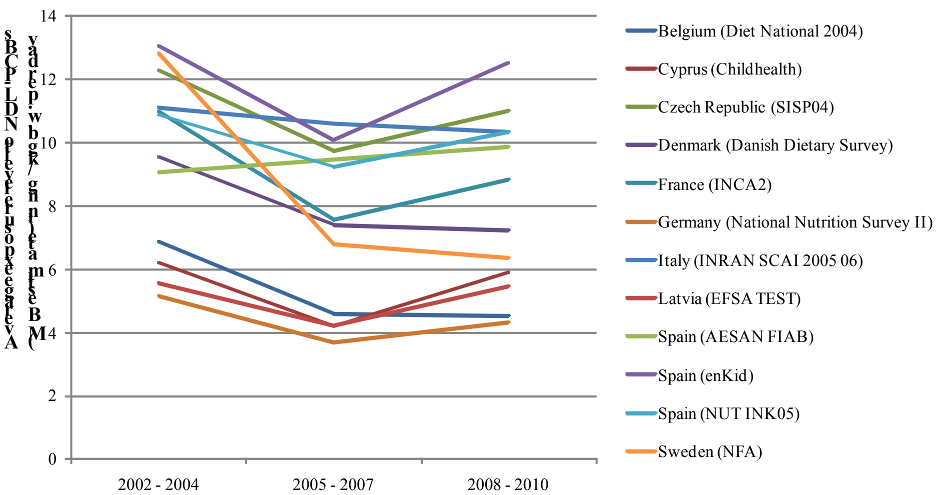

Figure 16: Average exposure of European adolescents to the sum of the 6 NDL-PCB indicators.

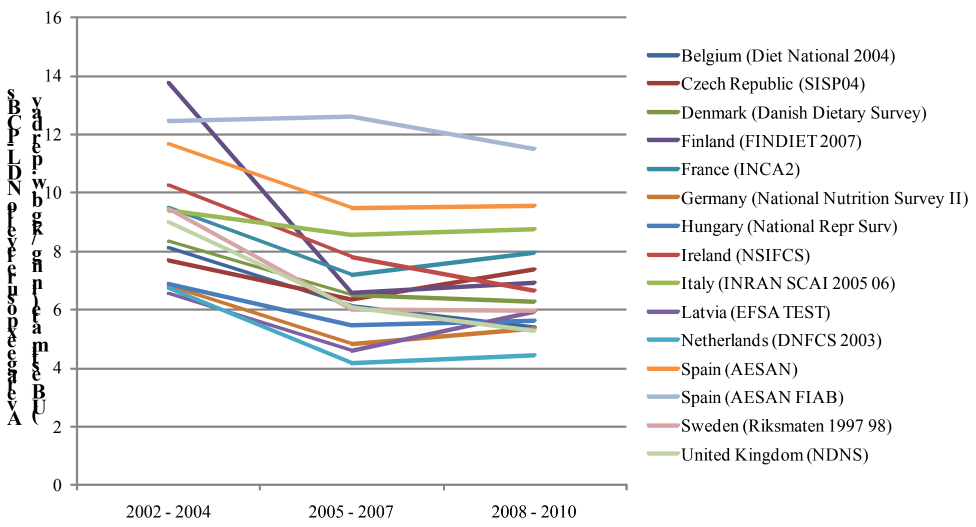

Figure 17: Average exposure of European adults to the sum of the 6 NDL-PCB indicators.

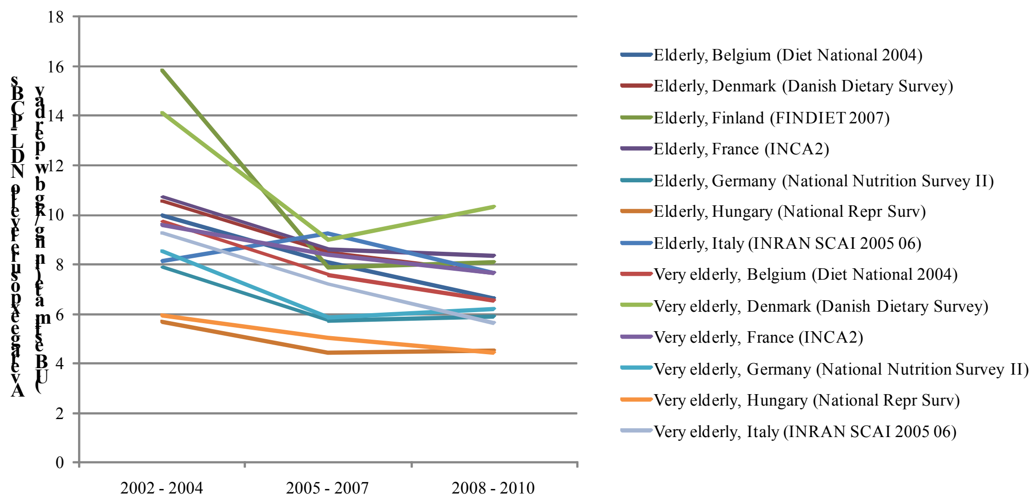

Figure 18: Average exposure of European elderly and very elderly to the sum of the 6 NDL-PCB indicators.

A peak of exposure was observed in some infant and toddler groups for the period 2005-2007. This can be explained by the specific contribution of ready-to-eat meals for infants and toddlers, for which quite high contamination levels were observed in the 2005-2007 period compared to the two other periods. It should be noted that the total number of samples available for foods for infants and young children was quite low in the period 2002-2004 (N = 20) and corresponding only to cereal-based foods for infants and young children (no NDL-PCB indicator found in these samples), for which the contamination level has been extrapolated to the other kind of foods for infants and young children. As a consequence, the exposure level for infants and toddlers for the period 2002-2004 may have been underestimated.

4.3.3. Uncertainties

Evaluation of the inherent uncertainties in the assessment of exposure to dioxins and PCBs was performed following the guidance of the Opinion of the Scientific Committee related to Uncertainties in the Dietary Exposure Assessment (EFSA, 2007). These are summarised in Table 23.

Table 23: Summary of qualitative evaluation of the impact of uncertainties on the dietary exposure.

Sources of uncertainty	Direction and magnitude*
Occurrence data	
Correction on the missing values	+ / -
Sampling strategy (selective, targeted sampling design)	+
Analysis, measurement error, sensitivity of the methods	+ / -
Low number of samples available in some food group	+ / -
Assumption made on the contamination level of some foods	+ / -
Effect of cooking on dioxins and PCBs concentration	+ / -
Representativeness of sample foods for consumed foods	+ / -
Extrapolation of occurrence data to whole Europe	+ / -
Consumption data	
Extrapolation of few days of consumption to long-term exposure	+ / -
Underreporting of consumption	-
Few individuals in some population groups	+ / -
Under sampling of consumers with specific consumption patterns	-
Exposure modelling	
Breast milk not taken into account	--
Food not taken into account when no or too few samples available, mainly food of plant origin (fats and oils excepted).	--
Time trend analysis	
Evolution of consumption patterns throughout the years not taken into account	+ / -

* Key to direction and magnitude:
+, ++, +++ = uncertainty likely to cause small, medium or large over-estimation of exposure;
-, - -, - - - = uncertainty likely to cause small, medium or large under-estimation of exposure.

The occurrence data used in the exposure assessment were mainly coming from monitoring programs. Due to the sampling strategy (selective/targeted sampling design) and to the performance of the analytical methods (which aimed to verify compliance with maximum limits), the exposure are considered to be overestimated. In fact, results from two recent TDS surveys (Windal *et al*., 2010; Sirot *et al.,* 2012), designed to assess background exposure of the general population, showed lower levels than those estimated in this report.

On the contrary, some foods have not been taken into account in the exposure assessment, especially those of plant origin (except vegetable oils and fats), which could have lead to an underestimation of the real exposure of the European population. According to the literature, products of plant origin would represent between 4.8 and 17.3 % of the total exposure to dioxins and DL-PCBs (De Mul *et al*., 2004, Fattore *et al*., 2006, Tard *et al*., 2007, Windal *et al*., 2010, Marin *et al*., 2011, Perello *et al*., 2012) and around 4-5 % of the total exposure to NDL-PCBs (Fattore *et al*., 2008, Arnich *et al*., 2009). Also, this exposure assessment didn't cover breastfeeding. As a consequence, results provided for infants cannot be considered as representative of this age group.

Finally, it should also be noted that all available occurrence data have been merged in order to produce a single "European" estimate without taking into account the variability of contamination throughout Europe. As a consequence, the exposure estimates produced at a population group level may sometimes be overestimated, sometimes underestimated.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

- At least one quantified congener was found in almost each of a total of 13,797 samples analysed for dioxins and DL-PCBs, whereas at least one of the six NDL-PCB indicators was quantified in respectively 68.4 % and 82.6 % of the 2,054 feed and 17,127 food samples analysed for their presence.

- Feed and food from animal origin contained higher levels of dioxins and PCBs than foods from plant origin. “Meat from eels” and “Fish liver and derived products” contained the highest average contamination levels for both dioxins and PCBs.

- The non-ortho PCBs was the main contributor to the total toxicity equivalents (TEQWHO05) of dioxins and DL-PCBs, representing between 21.0 and 74.5 % of the total TEQWHO05 level, followed by the polychlorinated dibenzo-p-dioxins (PCDDs) and the polychlorinated dibenzofurans (PCDFs), which together represented between 12.4 and 73.2 % of the total TEQ level. Concerning the NDL-PCBs, the PCB-153, followed by PCB-138 and PCB-180 represented altogether between 36.9 and 97.8 % of the sum of the six NDL-PCB indicators depending on the food and feed group.

- The level of dioxins and DL-PCBs exceeded the permitted maximum level in 9.7 % of the food samples and 2.3 % of the feed samples. The level of the six NDL-PCB indicators exceeded the ML in 3.0 % of the food samples and 2.4 % of the feed samples.

- A decrease in the contamination levels of dioxins and PCBs was observed over the years in the three food groups taken into consideration for the time trend analysis: “Raw milk and dairy products”, “Hen eggs and egg products” and “Muscle meat from fishes other than eels”.

- The six NDL-PCB indicators were found to represent around 50 % of the sum of the NDL-PCBs which were measured in the food samples. Levels of the six NDL-PCB indicators and DL-PCBs were positively correlated in all food and feed groups. The correlation level was depending on the food groups and sometimes influenced by outliers.

- Meat from sheep contained on average less dioxins and PCBs than meat from bovine animals. Eggs coming from battery rearing contained significantly less dioxins and PCBs than those coming from free range, organic and outdoor growing production. Farmed salmon and trout contained on average less dioxins and PCBs than wild caught salmon and trout. Herring, salmon and trout coming from the Baltic region were more contaminated by dioxins and PCBs than those coming from other regions. Milk at farms had higher levels of dioxins and DL-PCBs than milk from bulk, whereas the inverse was observed for the NDL-PCB indicators.

- Chronic dietary exposure to the sum of dioxins and DL-PCBs was estimated to be on average between 0.57 and 2.54 pg TEQ_{WHO05}/kg b.w. per day and at the 95th percentile between 1.2 and 9.9 pg TEQ_{WHO05}/kg b.w. per day depending on the population group. Between 1.0 and 52.9 % of individuals were estimated to exceed the TWI of 14 pg TEQ/kg b.w. The major contributor to total exposure was milk and dairy products for almost all infant and toddler groups, whereas it was fish and seafood products for most of the adolescents, adults, elderly and very elderly groups. Meat and meat products also contributed significantly to total exposure.

- A general decrease in exposure to the sum of dioxins and DL-PCBs was observed between 2002-2004 and 2008-2010, estimated to be between 16.6% and 79.3% according to the different population groups.

- Chronic dietary exposure to the sum of the six NDL-PCB indicators was estimated to be on average between 4.3 and 25.7 ng/kg b.w. per day and at the 95th percentile between 7.8 and 53.7 ng/kg b.w. per day depending on the population group. The major contributor to total exposure was either fish and seafood products or meat and meat products in the adolescents, adults, elderly and very elderly population groups. For some groups of infants, toddlers and other children, milk and dairy products and/or foods for infants and young children were major contributors to total exposure, while the other children group showed a similar pattern of exposure as adolescents or adults of the same country.

- A decrease in exposure to the sum of the six NDL-PCB indicators was observed between 2002-2004 and 2008-2010 in most but not all population groups, estimated to be between 2.0 and 75.6%.
- The estimated decrease over time is most likely an effect of the European risk management measures to reduce the exposure of the European population, but could to some extent also be due to improvements in the analytical methods used and changes to sampling design of the monitoring programs throughout the years.
- The current results should be interpreted with some caution. On the one hand, food contamination and population exposure may have been overestimated due to targeted sampling. On the other hand, not all foods have been taken into account in the exposure assessment, which may have lead to an underestimation of total exposure in some population groups. Finally, regional variations have not been considered as all occurrence data were merged to represent an overall European situation.

Recommendations

In order to improve the accuracy of the assessment of food contamination levels and exposure to dioxins and PCBs throughout Europe, it is important to clearly define the sampling strategy used both at the sample level and for the overall direction of monitoring programs. Further, results should be reported with a clear indication of the unit of expression of the result (on fat, whole weight or moisture basis), as it greatly impacts the estimation of the contamination levels of food and feed to dioxins and PCBs.

Big discrepancies were observed concerning the limit of detection/quantification of NDL-PCBs as well as the unit of reporting of the results within the same food/feed group. These differences were interpreted to be a consequence of the different regulatory frameworks in existence for analysing NDL-PCBs in food and feed at the time. The new regulations (EU) No 252/2012 and 278/2012 on the determination of the levels of dioxins and polychlorinated biphenyl in food and feed are a step forward. It is suggested to, as far as possible, measure dioxins and PCBs in food and feed samples according to the minimum analytical performance criteria applied as a cut-off in this report.

Finally, it is recommended to measure dioxins and DL-PCBs in those foods identified as main contributor to the total exposure of the population, but for which the estimations of the contamination levels were not robust.

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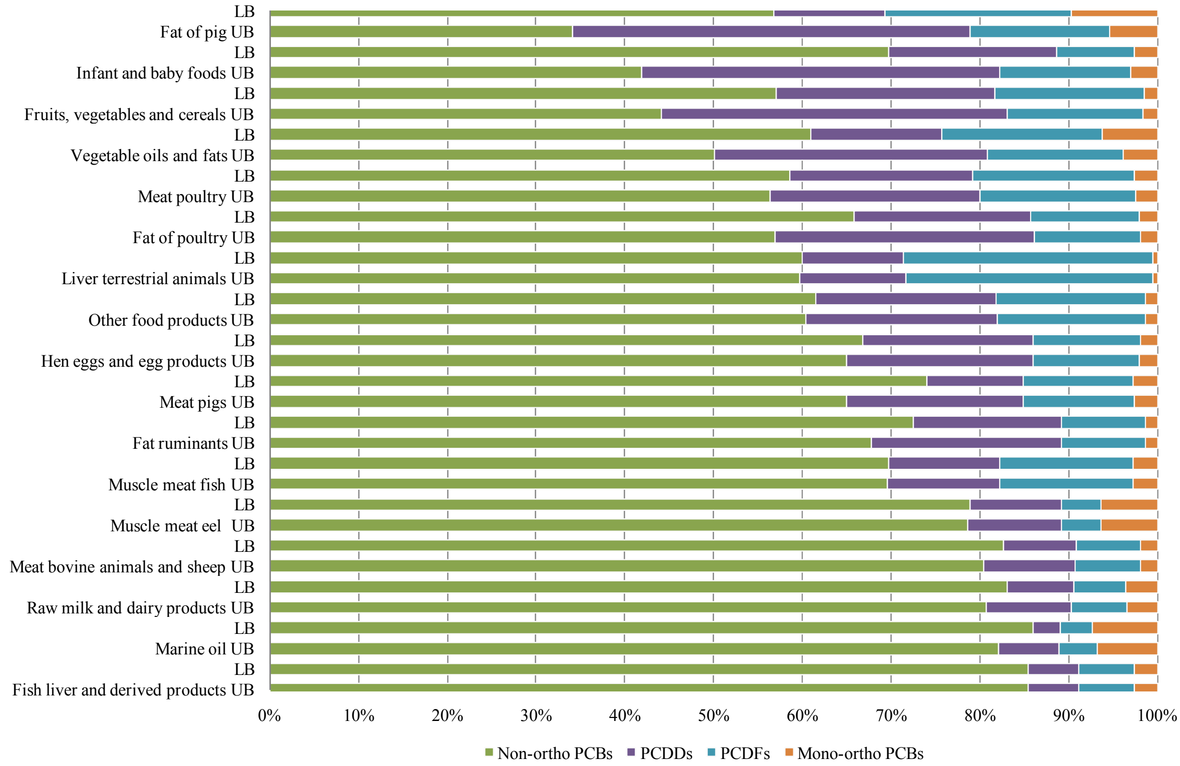
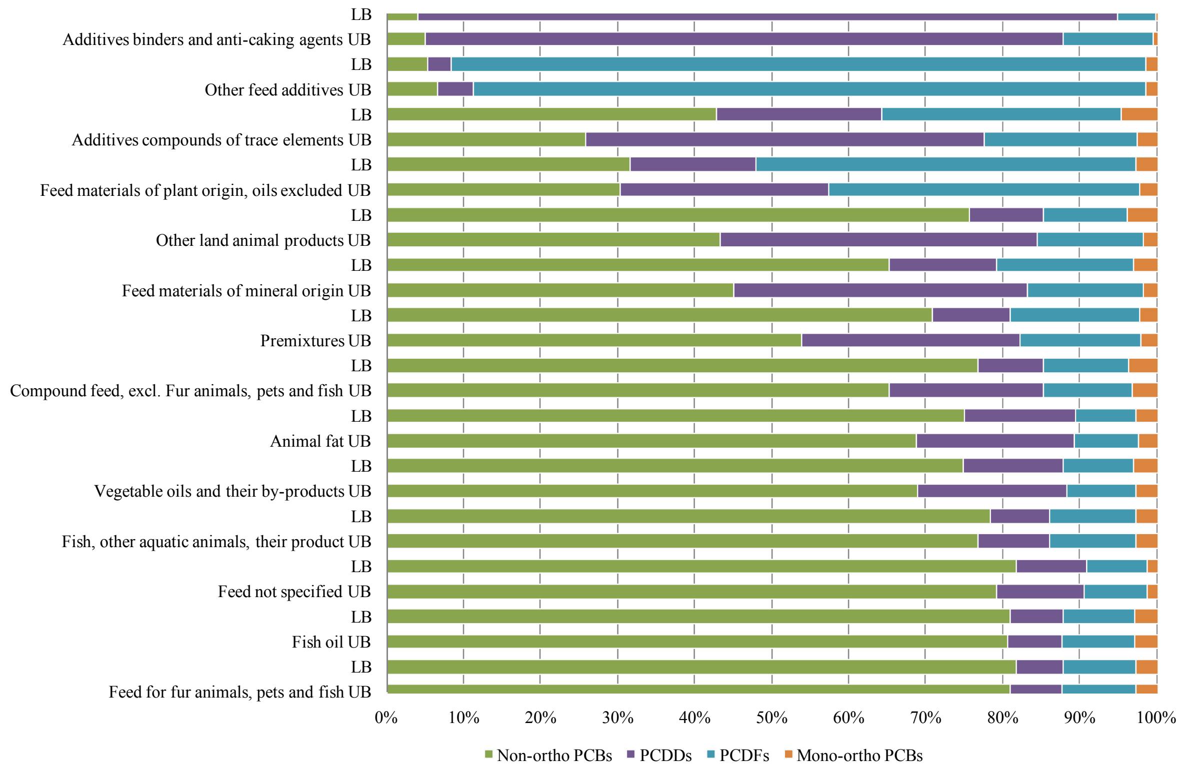
APPENDICES

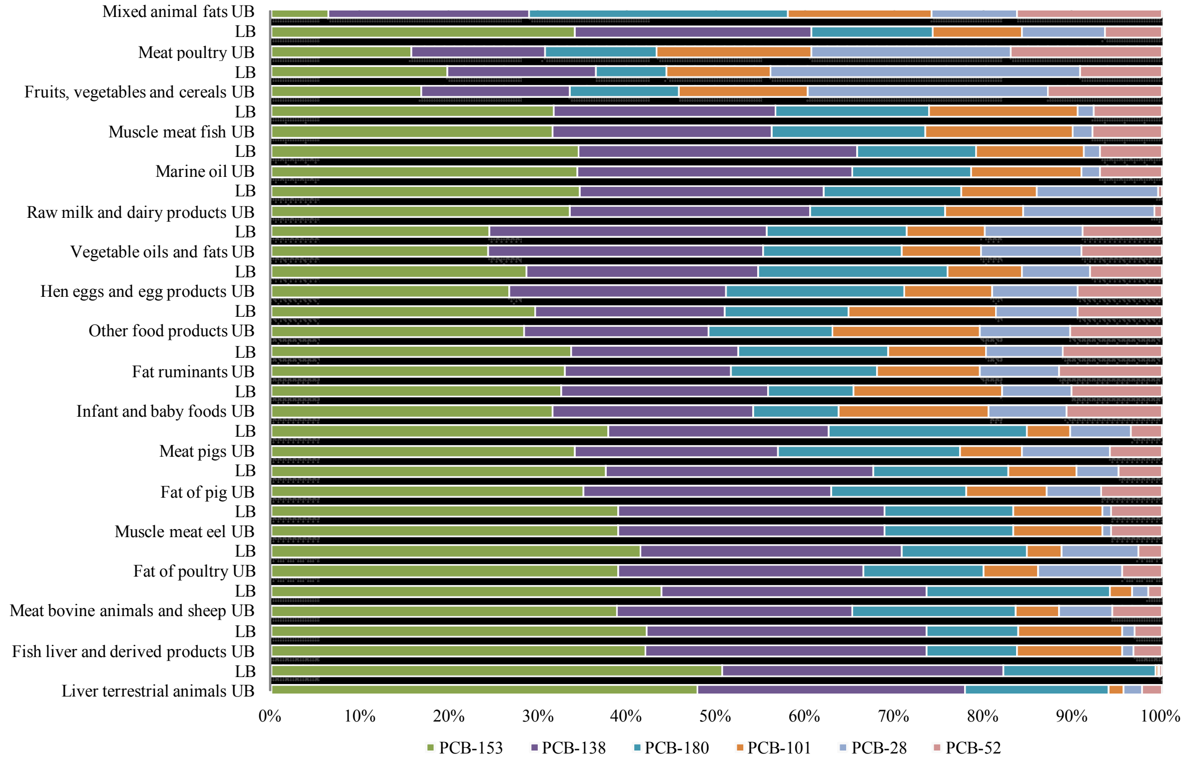
A. RELATIVE CONTRIBUTION OF PCDDS, PCDFS, NON-*ORTHO* PCBS AND MONO-*ORTHO* PCBS TO THE TOTAL TEQ_{WHO05} LEVEL OF DIOXINS AND DL-PCBS IN THE 5% MOST CONTAMINATED FOOD AND FEED SAMPLES.

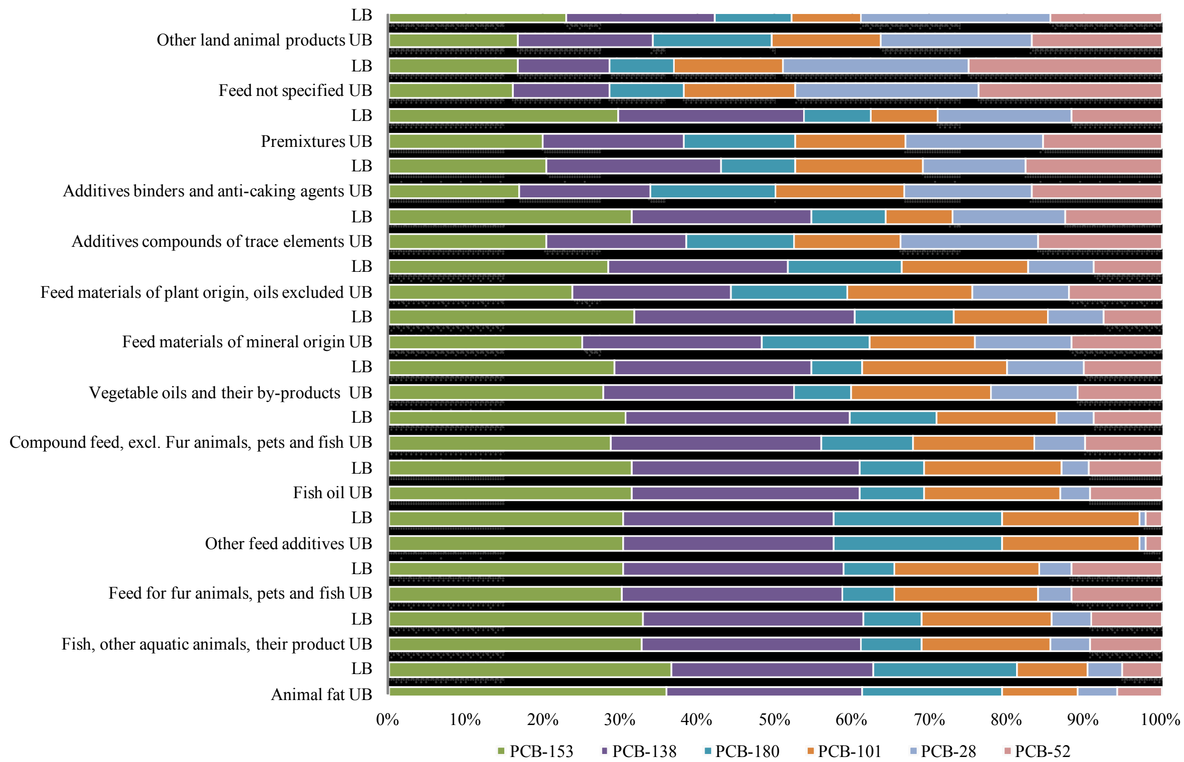




Legend: UB/LB: upper bound/ lower bound concentration.

B. Relative contribution of the 6 individual indicator PCBs to the sum of the 6 NDL-PCBs in the 5% most contaminated food and feed samples.



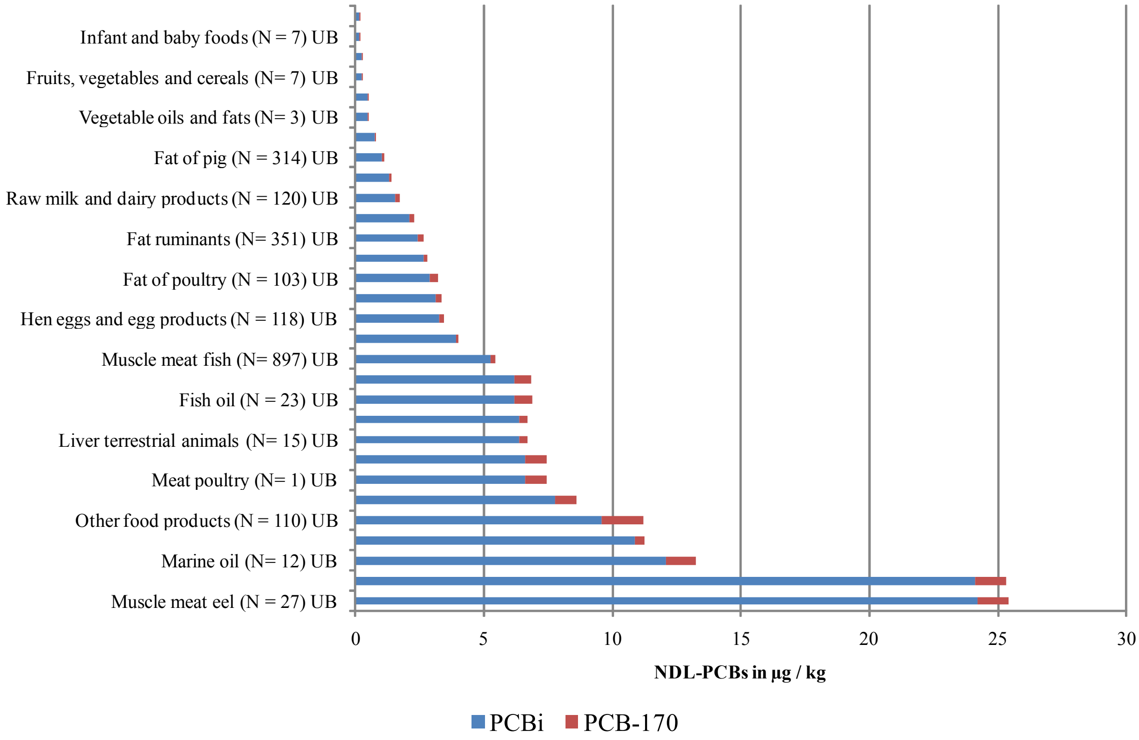


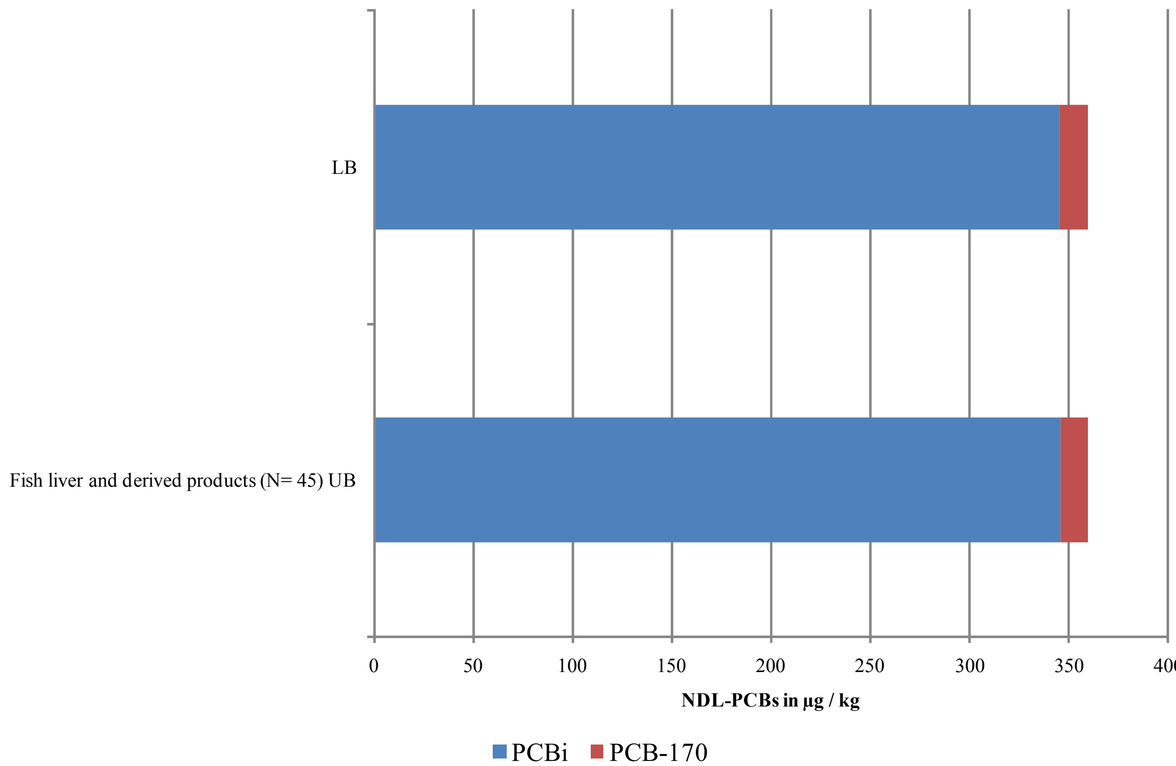
Legend: UB/LB: upper bound/ lower bound concentration.

C. Contribution of the individual NDL-PCBs to the total NDL-PCBs levels measured in food

✓ *PCB-170 and the 6 indicators in 16 different kinds of foods*

Results on the level of PCB-170, in addition to those of the 6 indicators, were available for 2,153 food samples. Depending on the kind of foods, PCB-170 represented on average between 2.8 and 14.5 % of the sum of the measured NDL-PCB levels. The highest contribution was observed on products of animal origin.

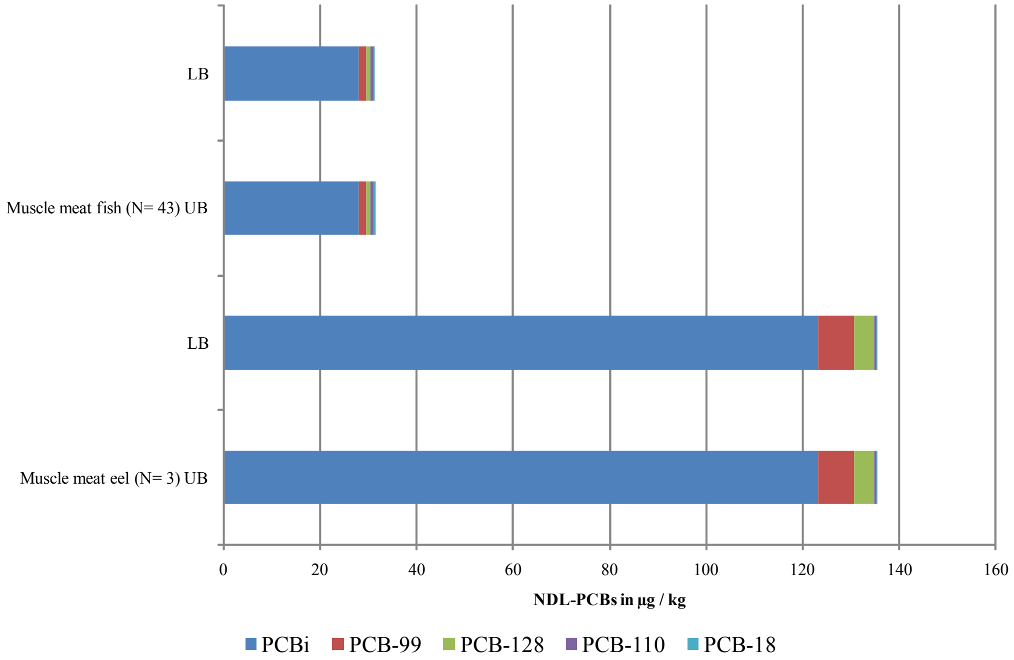




PCBi refers to the sum of the 6 NDL-PCB indicators.

✓ *4 different NDL-PCBs and the 6 indicators in 2 different kinds of foods*

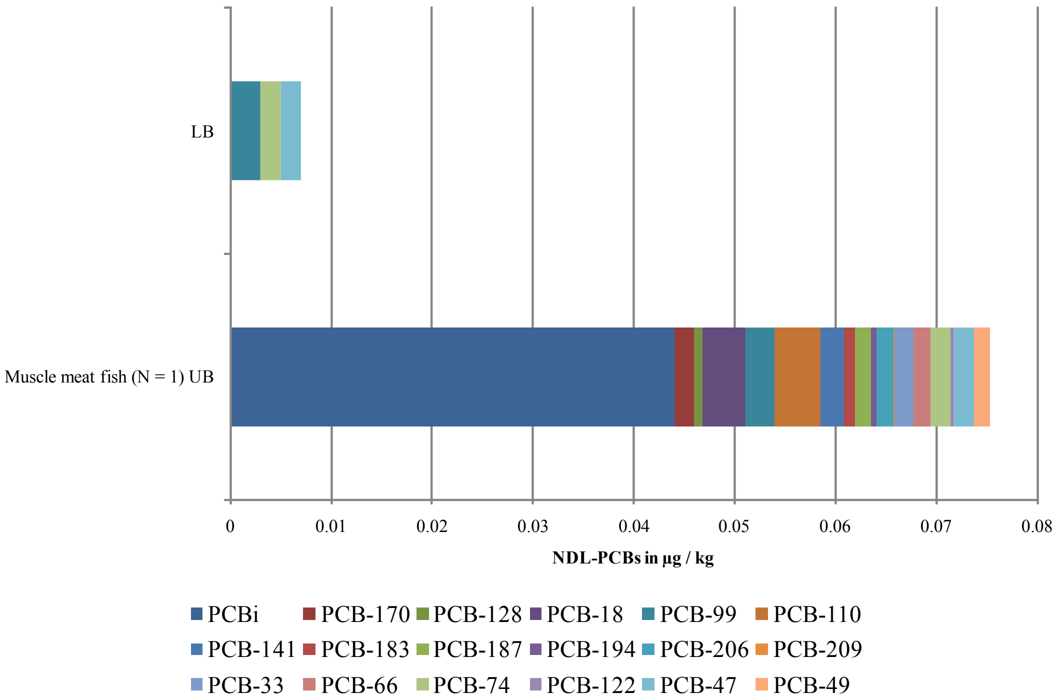
Results on the levels of PCB-18, -99, -110 and -128, in addition to those of the 6 indicators, were available for 46 food samples. They were found to represent 10 % of the sum of the measured NDL-PCBs in “Muscle meat from eel and fish”. PCB-18 contributed to less than 1% of the sum of the measured NDL-PCBs.



PCBi refers to the sum of the 6 NDL-PCB indicators.

✓ *17 different NDL-PCBs and the 6 indicators in muscle meat fish*

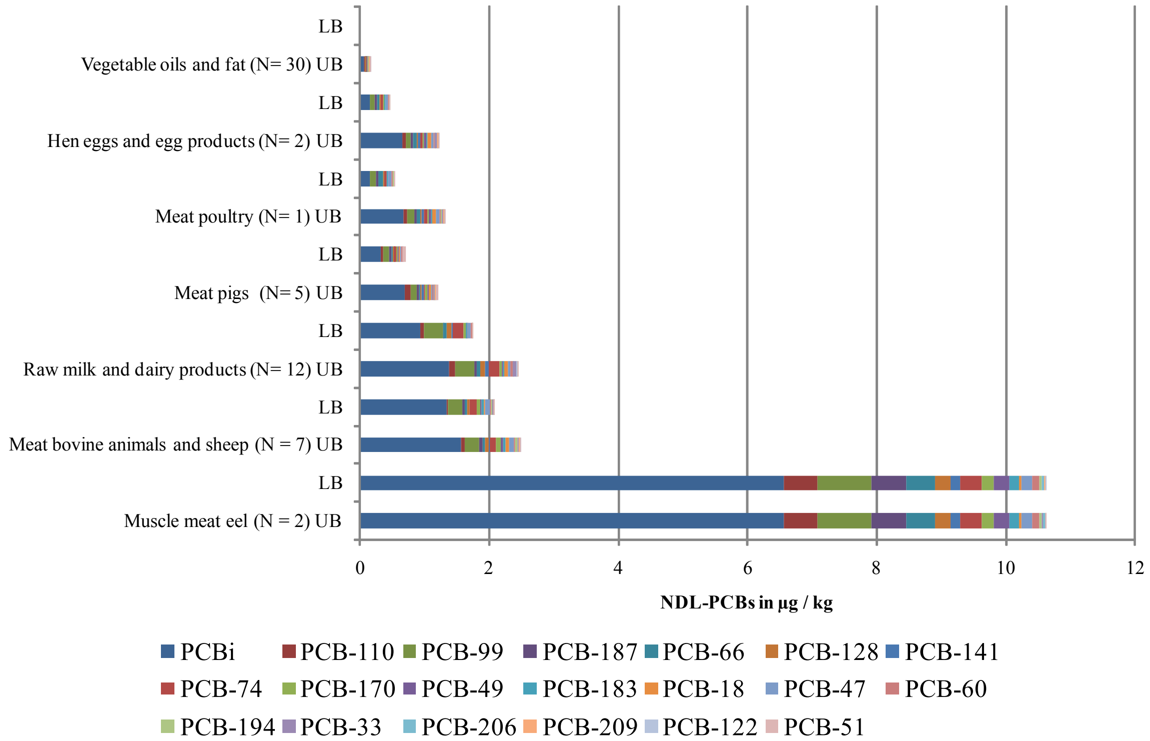
Results on the levels of PCB-18, -33, -47, -49, -66, -74, -99, -110, -122, -128, -141, -170, -183, -187, -194, -206, -209, in addition to those of the 6 indicators, were available for 1 sample of muscle meat fish. Only PCB-99, -74 and -47 were quantified.

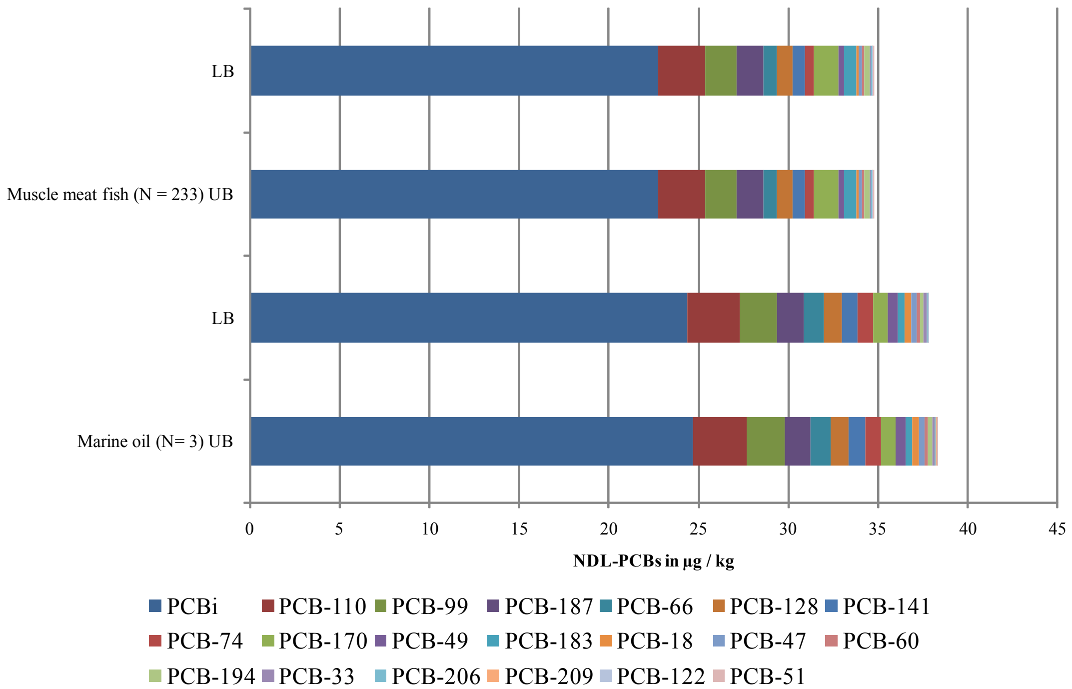


PCBi refers to the sum of the 6 NDL-PCB indicators.

✓ *19 different NDL-PCBs and the 6 indicators in 9 different kinds of food*

Results on the levels of PCB-18, -33, -47, -49, -51, -60, -66, -74, -99, -110, -122, -128, -141, -170, -183, -187, -194, -206 and -209, in addition to those of the 6 indicators, were available for 295 food samples. They were found to represent between 35 and 45 % of the sum of the measured NDL-PCBs for "Meat pigs", "Raw milk and dairy products", "Meat bovine animals and sheep", "Muscle meat from eels and other fish", "Marine oil", whereas they represented between 45 and 75 % of the sum for "Vegetable oils and fats", "Hen eggs and eggs products" and "Meat poultry". Among the 19 NDL-PCBs, the ones found at the highest levels were PCB-110, PCB-99 and PCB-187.

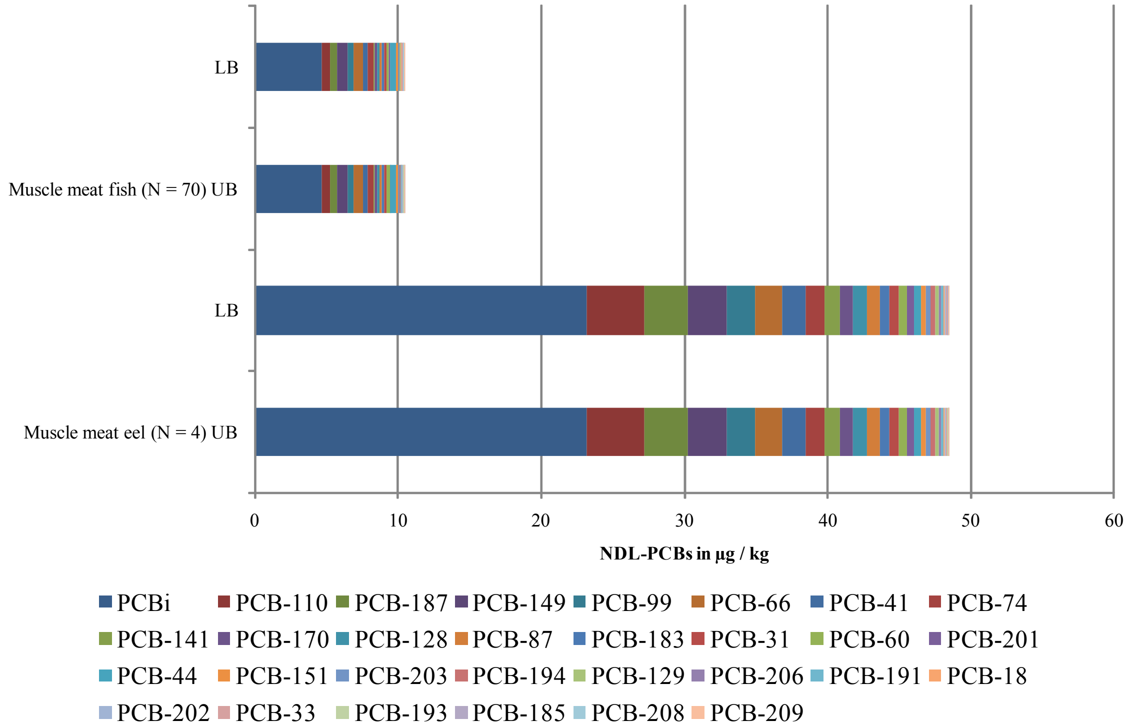




PCBi refers to the sum of the 6 NDL-PCB indicators.

✓ *29 different NDL-PCBs and the 6 indicators in 2 different kinds of food*

Results on the levels of PCB-18, -31, -33, -41, -44, -60, -66, -74, -87, -99, -110, -128, -129, -141, -149, -151, -170, -183, -185, -187, -191, -193, -194, -201, -202, -203, -206, -208 and -209, in addition to those of the 6 indicators, were available for 74 food samples. The 29 other NDL-PCBs analysed represented respectively 52 and 54 % of the sum of the measured NDL-PCBs in “Muscle meat eel” and “Muscle meat fish”. Among them, the ones with the highest levels were still PCB-110, PCB-99 and PCB-187. PCB-149 which was not present in the 19 NDL-PCB was also found with relatively high level compared to the others.



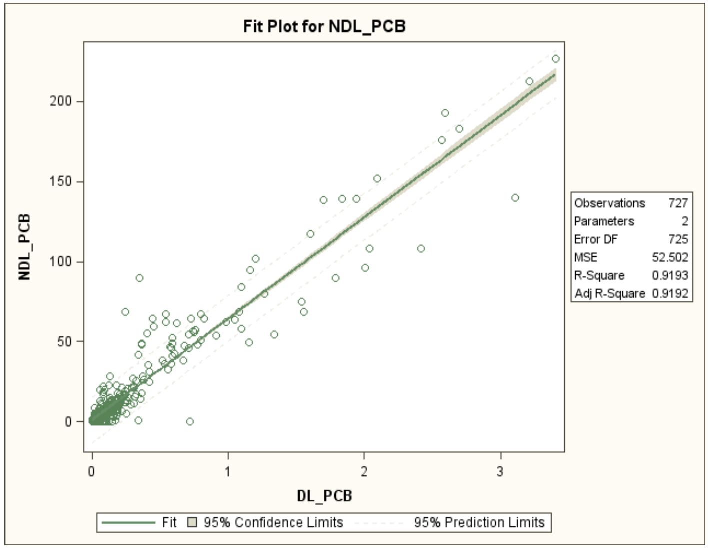
PCBi refers to the sum of the 6 NDL-PCB indicators.

D. Relationship between the sum of the six NDL-PCB indicators and the total TEQ_{WHO05} of the 12 DL-PCBs

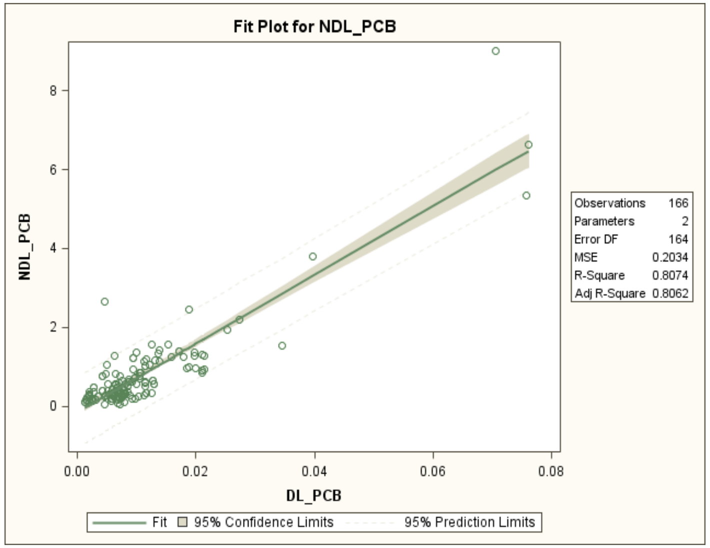
Food / Feed group	N[a]	r[b]	Intercept[c]	Slope[c]	Remark
Fat of pig	166	0.81	-0.15	86.96	
Fat of poultry	64	0.87	-0.05	79.21	
Fat ruminants	258	0.01	1.15	49.24	Strongly influenced by few outliers. When excluding two samples from the analysis, the correlation coefficient was estimated at 0.88
Fish liver and derived products	32	0.63	-6.55	44.90	
Fruits, vegetables and cereals	30	0.31	0.04	27.32	
Hen eggs and egg products	210	0.77	2.73	46.21	Influenced by few outliers. When excluding one sample from the analysis, the correlation coefficient was estimated at 0.67
Infant and baby foods	68	0.11	0.12	17.79	
Liver terrestrial animals	33	0.38	-2.10	159.01	
Marine oil	33	0.49	5.48	90.26	
Meat bovine animals and sheep	124	0.44	3.53	53.67	Strongly influenced by few outliers. When excluding one samples from the analysis, the correlation coefficient was estimated at 0.88
Meat pigs	32	0.9	-6.22	283.22	Strongly influenced by few outliers. When excluding one samples from the analysis, the correlation coefficient was estimated at 0.27
Meat poultry	37	0.32	1.96	53.31	
Muscle meat eel	160	0.54	7.18	75.50	
Muscle meat fish	1,647	0.71	1.24	73.75	
Other food products	116	0.67	-4.81	130.08	Strongly influenced by few outliers. When excluding one samples from the analysis, the correlation coefficient was estimated at 0.27
Raw milk and dairy products, including butter fat	213	0.13	1.88	10.91	
Vegetable oils and fats	17	0.14	0.15	34.10	
Feed	727	0.91	0.78	63.45	

(a): number of samples, (b): correlation coefficient, (c): estimates of the parameters of the following regression model: [NDL-PCB] = intercept + slope [DL-PCB] + error, with [NDL-PCB] corresponding to the sum of the six indicators in µg/kg and [DL-PCB] corresponding to the sum of the 12 DL-PCBs expressed in pg TEQ_{WHO05}/g.

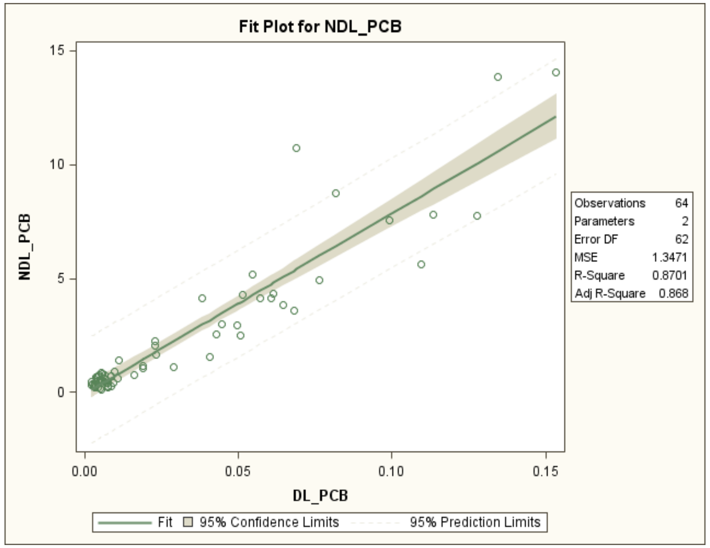
Feed



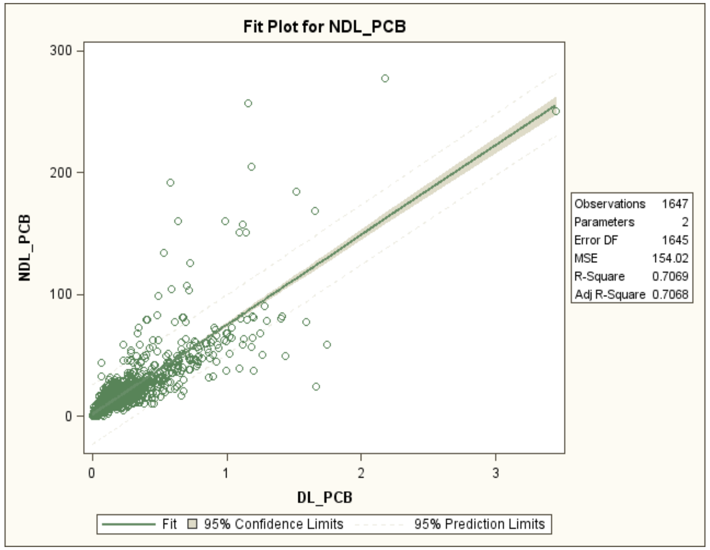
Fat of pig



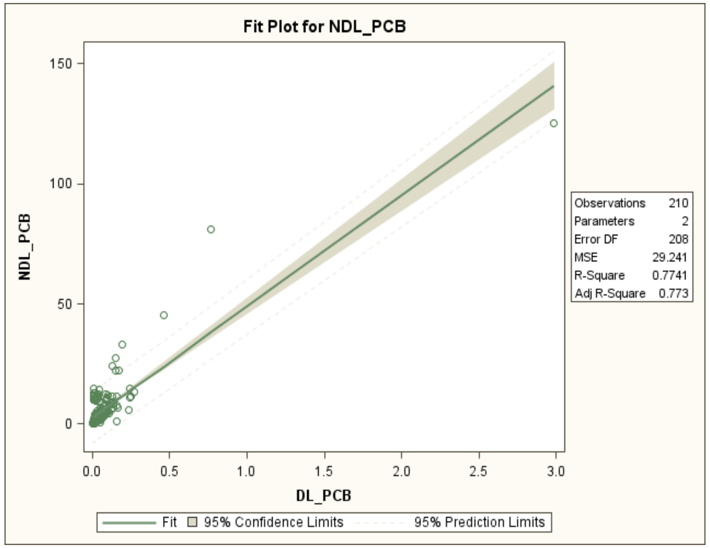
Fat of poultry



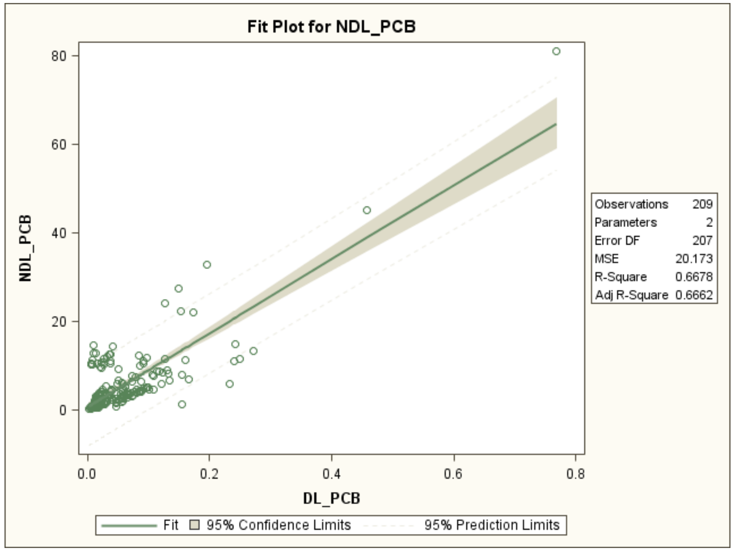
Meat fish other than eel



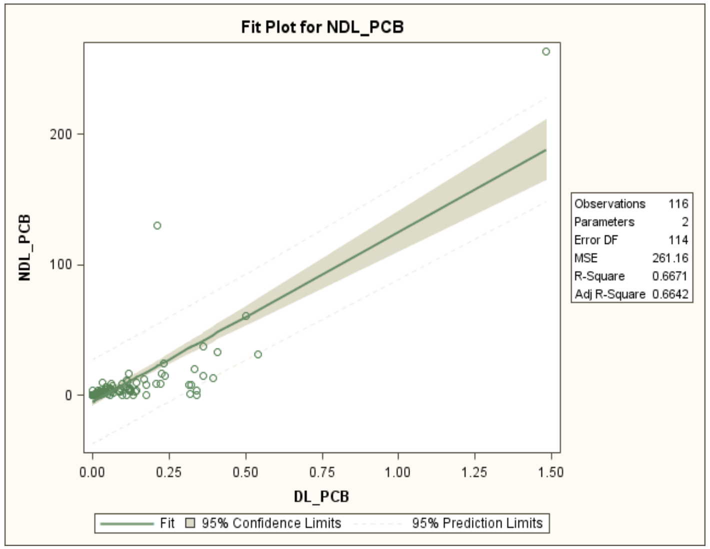
Hen eggs and egg products (all data)



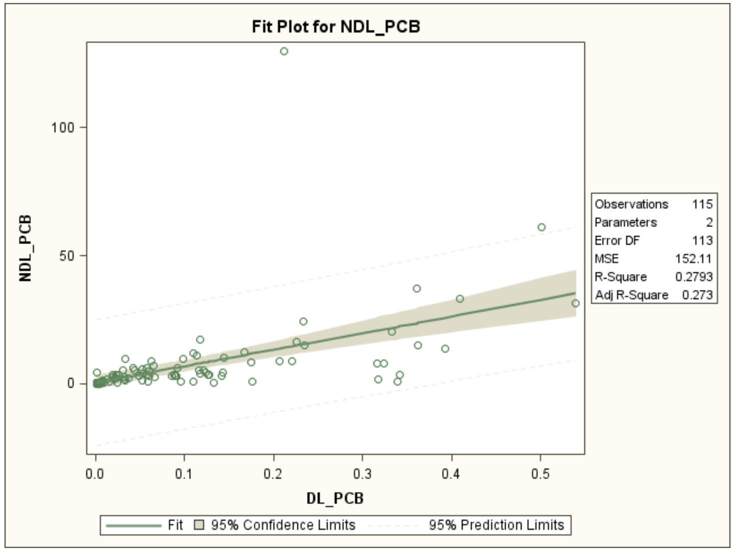
Hen eggs and egg products (without one outlier)



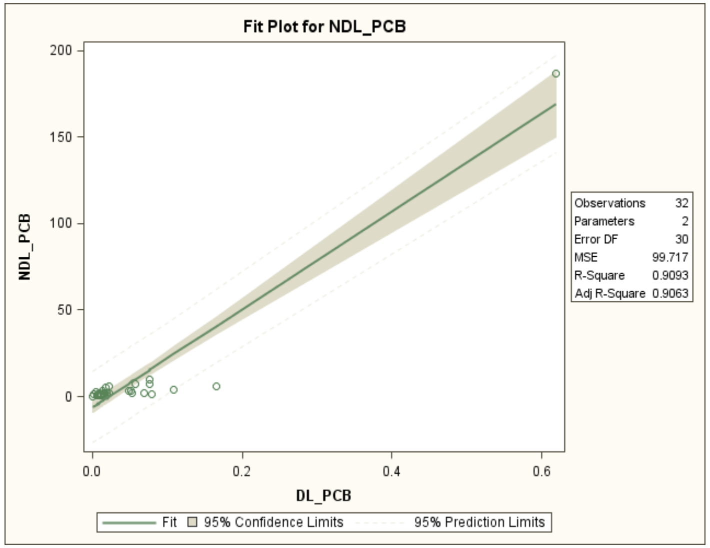
Other food products (all data)



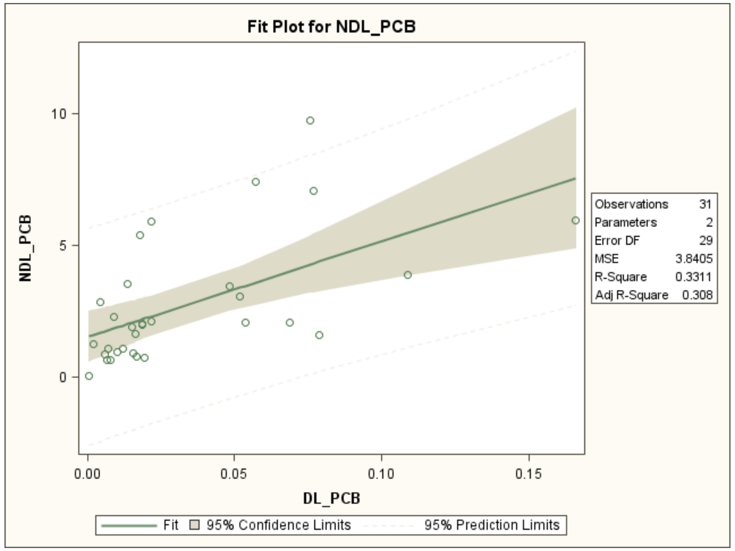
Other food products (without one outlier)



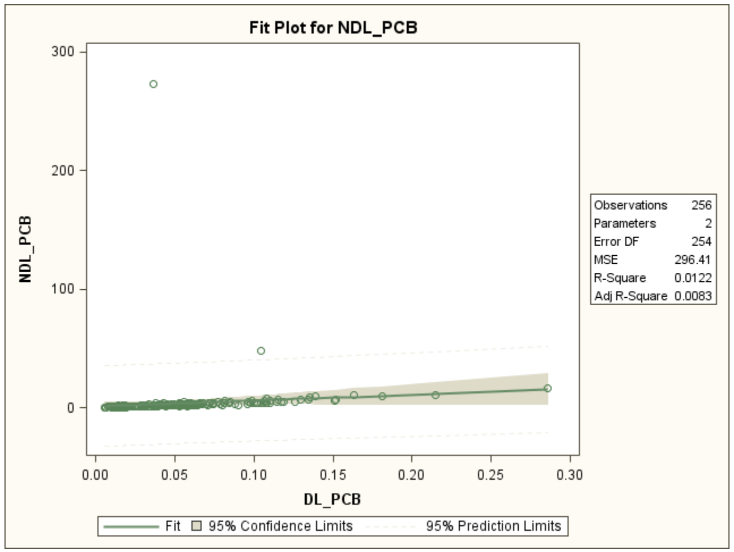
Meat of pig (all data)



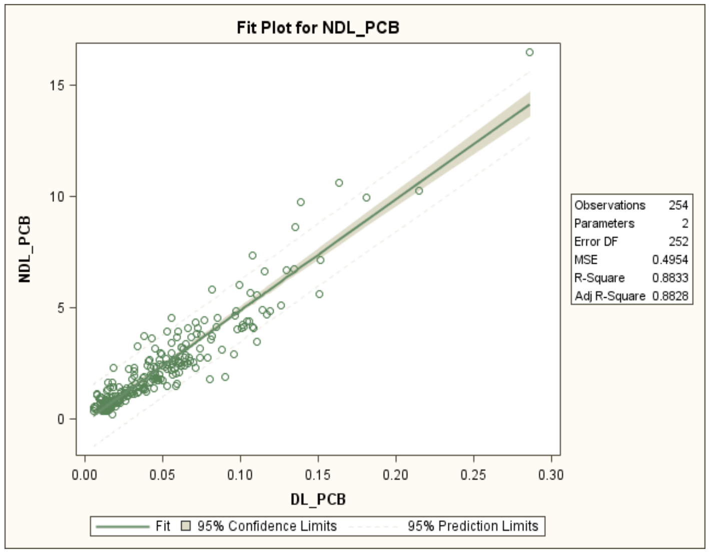
Meat of pig (without one outlier)



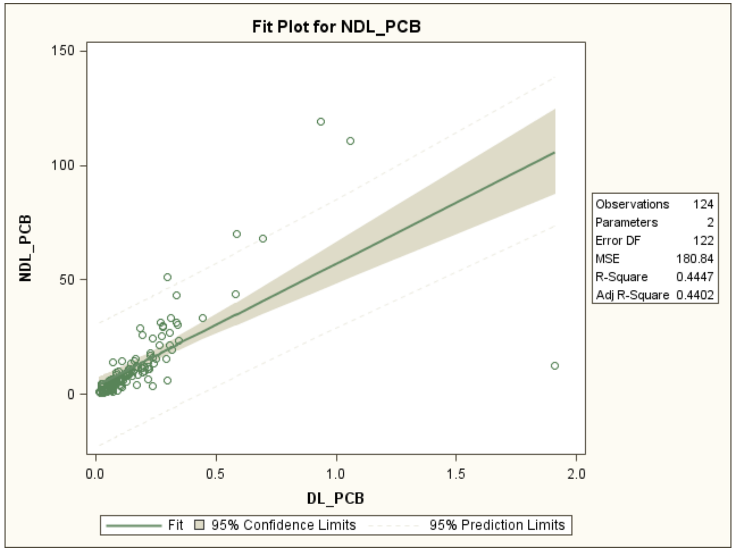
Fat of ruminant (all data)



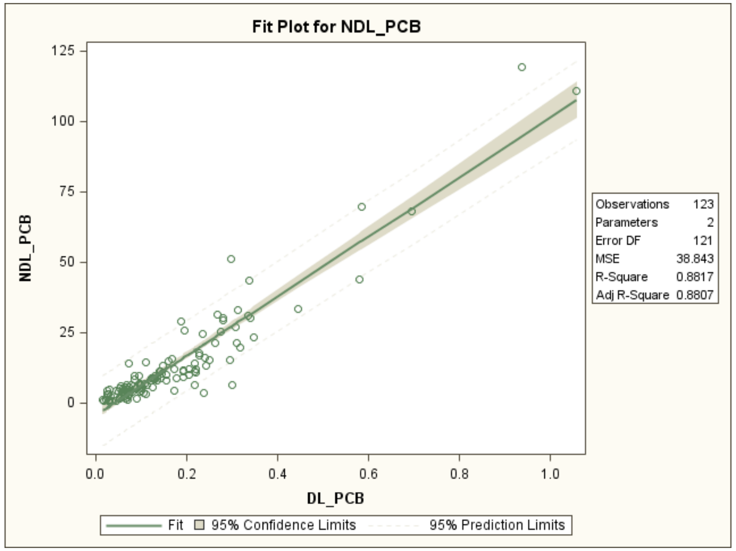
Fat of ruminant (without two outliers)



Meat from bovine animals (all data)



Meat from bovine animals (without one outlier)



E. ASSUMPTIONS FOR THE EXPOSURE ASSESSMENT

✓ *Dioxins and DL-PCBs*

Food groups	Description of the assumption
Duck fat, goose fat	As chicken fat
Barbel, flounder	As the group of following fishes: babel, sprat, herring, whitefish, bream, halibut, salmon and trout, sardine and pilchard, flounder and char
Carp, tuna and bass	As the group of following fishes: char, tuna, bass, plaice, rays, sole and carp
Fish meat	All fishes, eels excluded
Fish ball, fishcake, fish finger, fish pâte	As the group of fish finger and fish pâte
Infant formulae liquid	As infant formulae powder divided by a dilution factor of 8
Kidney (beef, pork, mutton/lamb, veal), brain, giblet, heart, lungs, marrowbone, spleen, stomach, tail, thymus, tongue, totters and feet	As edible offals from farmed animals, livers excluded
Duck / goose / turkey livers	As livers of chicken
Horse meat	As the group of horse, beef and veal meats
Sheep milk	As liquid milks without cow milk

Groups were defined based on a comparison of the contamination levels, using T-Test with Bonferroni adjustments on SAS software.

✓ *NDL-PCB indicators*

Food groups	Description of the assumption
Duck fat, goose fat	As chicken fat
Butter oil	As butter
Anchovy, barbel, char, flounder	As the group of following fishes: anchovy, barbel, char, flounder, sprat, mackerel, herring, whitefish, halibut, bream
Bass, hake, lophiiformes, plaice	As the group of following fishes: bass, hake, lophiiformes, plaice, sole, cod and whiting, rays
Fish meat	All fishes, eels excluded
Follow-on formula, milk-based, powder	As the group of "follow-on formula, milk-based, liquid"
Infant formulae liquid	As infant formulae powder divided by a dilution factor of 8
Kidney (beef, veal), brain, heart, lungs, marrowbone, spleen, stomach, tail, thymus, tongue, totters and feet	As the group of kidney (beef, pork, mutton/lamb, veal), brain, giblet, heart, lungs, marrowbone, spleen, stomach, tail, thymus, tongue, totters and feet
Duck / goose / turkey livers	As livers of chicken

F. REVIEW OF THE LITERATURE ON EXPOSURE OF THE EUROPEAN POPULATION

✓ *Dioxins and DL-PCBs*

Country (region)	Population group	Kind of survey	Exposure estimates	Source
Netherlands	Infants non breastfed (5 months)	NS	Mean/95th percentile: 1.1 / 1.7 pg TEQ_{WHO98}/ kg b.w. per day	Weijs *et al*. 2006
Italy	Infants non breastfed and toddlers	Monitoring	Mean/95th percentile: 5.34 / 12.8 pg TEQ_{WHO98}/ kg b.w. per day	Fattore *et al*. 2006
Europe	Infants non breastfed (0 – 9 months)	Market basket	Mean: 0.14 – 1.27 pg TEQ_{WHO98}/ kg b.w. per day	Pandelova *et al*. 2011
Netherlands	Toddlers non breastfed (12 months)	NS	Mean/95th percentile : 2.3 / 3.7 pg TEQ_{WHO98}/kg b.w. /day	Weijs *et al*. 2006
Sweden	Toddlers	Monitoring / Market basket	Mean/95th percentile: 4.2 – 4.3 / 6.6 – 8.1 pg TEQ $_{WHO98}$/ kg b.w. per day	Bergkvist *et al*., 2008
UK	Children	TDS	Mean: 0.7 – 1.8 pg TEQ_{WHO98}/kg b.w / day	FSA, 2003
Italy	Children	Monitoring	Mean/95th percentile: 3.37 / 7.16 pg TEQ_{WHO98}/ kg b.w. per day	Fattore *et al*. 2006
France	Children	Monitoring	Mean/95th percentile: 2.8 / 6.0 pg TEQ_{WHO98}/ kg b.w. per day	Tard *et al*., 2007
Sweden	Children	Monitoring / Market basket	Mean/95th percentile: 2.7 – 4.5 / 4.6 – 7.6 pg TEQ $_{WHO98}$/ kg b.w. per day	Bergkvist *et al*., 2008
Spain (Valencia)	Children	Monitoring	Mean: 4.58 pg TEQ_{WHO98}/ kg b.w. per day	Marin *et al*. 2011
France	Children	TDS	Mean/95th percentile: 0.88 / 2.02 pg TEQ_{WHO98}/ kg b.w. per day	Sirot *et al.*, 2012
Sweden	Adolescents	Monitoring / Market basket	Mean /95th percentile: 1.5 – 2.1 / 3.3 – 5.1 pg TEQ $_{WHO98}$/ kg b.w. per day	Berkvist *et al*., 2008
Italy	Adolescents and adults	Monitoring	Mean/95th percentile: 2.28 / 5.00 pg TEQ_{WHO98}/ kg b.w. per day	Fattore et *al*. 2006
Spain (Catalonia)	Adolescents and adults	Market basket	Mean/ 95th percentile: 0.75 / 1.28 pg TEQ_{WHO05}/ kg b.w. per day	Perello *et al*. 2012
UK	Adults	TDS	Mean: 0.9 pg TEQ_{WHO98}/kg b.w / day	FSA, 2003
Finland	Adults	Market basket	Mean: 1.5 pg TEQ_{WHO98}/ kg b.w. per day	Kiviranta *et al*. 2004
France	Adults	Monitoring	Mean/95th percentile: 1.8 / 3.9 pg TEQ_{WHO98}/ kg b.w. per day	Tard *et al*., 2007
Belgium	Adults	TDS	Mean: 0.61 pg TEQ_{WHO05}/ kg b.w. per day	Windal *et al*. 2010
Spain (Valencia)	Adults	Monitoring	Mean: 2.86 pg TEQ_{WHO98}/ kg b.w. per day	Marin *et al*. 2011

Country (region)	Population group	Kind of survey	Exposure estimates	Source
France	Adults	TDS	Mean/95th percentile: 0.57 / 1.29 pg TEQ_{WHO98}/kg b.w / day	Sirot *et al.,* 2012
Netherlands	General population	NS	Median / 95th percentile: 0.9 / 1.8 pg TEQ_{WHO05}/ kg b.w. per day	De Mul *et al.* 2008
Sweden	General population	Market basket	Mean: 0.6 pg TEQ_{WHO05}/ kg b.w. per day	Törnkvist *et al*. 2011

✓ *NDL-PCB indicators*

Country (region)	Population group	Kind of survey	Exposure estimates	Source
Italy	Infants, toddlers, and children up to 6 years	Monitoring	Mean/95th percentile: 24.6 / 60.0 ng/ kg b.w. per day for the sum of the 6 NDL-PCB indicators	Fattore *et al*. 2008
Italy	Children from 7 years and adolescents up to 12	Monitoring	Mean/95th percentile: 16.1 / 33.8 ng/ kg b.w. per day for the sum of the 6 NDL-PCB indicators	Fattore *et al*. 2008
France	Children	Monitoring / TDS	Mean/95th percentile: 12.9 / 27.3 ng/ kg b.w. per day for the sum of the 6 NDL-PCB indicators	Arnich *et al*., 2009
France	Children	TDS	Mean/95th percentile: 3.77 / 11.7 ng/ kg b.w. per day for the sum of the 6 NDL-PCB indicators	Sirot *et al.,* 2012
Italy	Adolescents and adults	Monitoring	Mean/95th percentile: 10.9 / 23.8 ng/ kg b.w. per day for the sum of the 6 NDL-PCB indicators	Fattore *et al*. 2008
France	Adults	Monitoring / TDS	Mean/95th percentile: 7.7 / 16.0 ng/ kg b.w. per day for the sum of the 6 NDL-PCB indicators	Arnich *et al*., 2009
Germany (Bavaria)	Adults	Duplicate diet	Median: 5.6 ng/ kg b.w. per day for the sum of the 6 NDL-PCB indicators **multiplied by a factor 2**	Fromme *et al*. 2009
France	Adults	TDS	Mean/95th percentile: 2.71 / 7.90 ng/kg b.w / day for the sum of the 6 NDL-PCB indicators	Sirot *et al.,* 2012
Slovak republic	General population	Monitoring	Median / 95th percentile: 17.0 / 45.0 ng/ kg b.w. per day for the sum of the 6 NDL-PCB indicators	Salgovicova *et al*., 2007
Europe	General population	Monitoring	Mean: 15 ng/ kg b.w. per day, high consumer of meat: 20 ng/ kg b.w. per day, high consumer of fish: 35 ng/ kg b.w. per day for the sum of the 6 NDL-PCB indicators	EFSA, 2005

G. Relative contribution (%) of the main food groups to the average exposure

✓ *Dioxins and DL-PCBs*

Country	Survey acronym	Fish	Milk	Meat	Fat	Egg	Infants[(a)]	Other[(b)]
				Infants				
Bulgaria	NUTRICHILD	7.71	32.47	15.62	19.62	2.86	21.70	0.02
Italy	INRAN SCAI 2005 06	27.98	31.30	2.54	7.13	0.08	30.90	0.07
				Toddlers				
Belgium	Regional Flanders	23.35	49.62	17.56	6.27	0.00	3.21	0.00
Bulgaria	NUTRICHILD	22.10	22.94	28.57	20.87	4.29	1.17	0.06
Finland	DIPP	51.76	18.08	19.68	5.10	1.10	4.27	0.00
Germany	DONALD 2006	15.23	34.14	28.20	8.76	2.43	11.19	0.06
Germany	DONALD 2007	27.09	28.39	20.37	9.29	3.55	11.24	0.07
Germany	DONALD 2008	27.52	27.45	19.41	9.40	3.26	12.95	0.00
Italy	INRAN SCAI 2005 06	35.84	36.40	10.38	9.61	2.64	4.80	0.34
Netherlands	VCP kids	10.93	38.48	33.73	11.09	2.80	2.93	0.05
Spain	enKid	10.67	47.18	33.06	4.37	0.00	4.69	0.03
				Other children				
Belgium	Regional Flanders	31.29	42.27	19.16	5.43	0.01	1.79	0.04
Bulgaria	NUTRICHILD	25.47	19.36	31.09	19.84	4.06	0.08	0.10
Czech Republic	SISP04	42.34	16.49	21.98	15.64	3.39	0.03	0.13
Denmark	Danish Dietary Survey	33.00	20.13	24.48	19.69	2.69	0.00	0.01
Finland	DIPP	45.42	18.90	23.12	10.05	2.45	0.05	0.02
Finland	STRIP	47.52	18.72	25.48	7.05	1.01	0.02	0.20
France	INCA2	44.09	17.53	25.68	9.98	2.41	0.28	0.03
Germany	DONALD 2006	27.37	25.03	31.15	11.12	4.20	0.95	0.18
Germany	DONALD 2007	23.13	29.88	30.84	10.71	4.61	0.67	0.15
Germany	DONALD 2008	29.18	26.02	30.27	9.83	4.11	0.43	0.17
Greece	Regional Crete	45.49	33.84	12.51	3.97	3.90	0.10	0.19
Italy	INRAN SCAI 2005 06	50.93	19.96	14.71	10.21	3.78	0.33	0.08
Latvia	EFSA TEST	36.04	21.79	30.41	9.70	2.01	0.00	0.05
Netherlands	VCP kids	17.05	34.43	32.32	11.99	3.07	1.10	0.04
Spain	enKid	40.95	22.76	29.57	6.42	0.02	0.24	0.04
Spain	NUT INK05	56.99	17.50	20.56	4.89	0.00	0.00	0.06
Sweden	NFA	34.56	27.40	31.35	4.00	1.72	0.82	0.15
				Adolescent				
Belgium	Diet National 2004	38.16	20.62	25.60	12.42	3.10	0.05	0.05
Cyprus	Childhealth	62.84	24.14	9.68	2.28	0.96	0.01	0.09
Czech Republic	SISP04	40.22	14.14	24.95	17.30	3.31	0.00	0.08
Denmark	Danish Dietary Survey	30.18	22.18	29.21	15.68	2.75	0.00	0.01
France	INCA2	44.03	15.18	29.54	8.93	2.29	0.00	0.03
Germany	National Nutrition Survey II	23.40	21.12	37.39	16.87	1.12	0.00	0.11
Italy	INRAN SCAI 2005 06	55.93	18.28	13.50	9.32	2.94	0.01	0.02
Latvia	EFSA TEST	26.89	22.06	36.32	12.03	2.64	0.00	0.06
Spain	AESAN FIAB	44.71	11.70	29.74	9.53	4.30	0.00	0.02
Spain	enKid	50.46	12.59	30.72	6.14	0.01	0.02	0.05
Spain	NUT INK05	56.93	13.10	24.14	5.79	0.00	0.00	0.04
Sweden	NFA	36.33	24.56	34.51	3.25	1.23	0.01	0.12

Country	Survey acronym	Fish	Milk	Meat	Fat	Egg	Infants[(a)]	Other[(b)]
Adult								
Belgium	Diet National 2004	51.80	15.48	18.83	11.51	2.31	0.02	0.06
Czech Republic	SISP04	43.10	11.37	28.08	14.53	2.85	0.00	0.07
Denmark	Danish Dietary Survey	42.39	16.19	23.87	15.07	2.47	0.00	0.01
Finland	FINDIET 2007	60.68	12.60	15.37	8.81	1.99	0.00	0.55
France	INCA2	52.40	12.91	23.81	8.71	2.11	0.00	0.05
Germany	National Nutrition Survey II	47.85	13.40	25.59	11.62	1.38	0.00	0.15
Hungary	National Repr Surv	19.03	18.07	35.90	20.48	6.38	0.00	0.13
Ireland	NSIFCS	39.55	13.05	32.20	12.62	2.09	0.00	0.49
Italy	INRAN SCAI 2005 06	63.19	14.68	11.38	8.25	2.44	0.00	0.05
Latvia	EFSA TEST	56.11	12.57	22.18	7.49	1.59	0.00	0.07
Netherlands	DNFCS 2003	22.73	28.57	37.71	9.52	1.40	0.02	0.06
Spain	AESAN	62.33	8.60	18.01	7.56	3.47	0.00	0.03
Spain	AESAN FIAB	62.90	10.46	16.31	6.93	3.38	0.00	0.01
Sweden	Riksmaten 1997 98	58.76	15.15	20.42	3.48	2.16	0.00	0.03
United Kingdom	NDNS	52.85	14.50	22.59	6.17	3.62	0.02	0.25
Elderly								
Belgium	Diet National 2004	58.82	10.78	13.86	14.98	1.48	0.00	0.09
Denmark	Danish Dietary Survey	55.43	12.33	16.10	13.81	2.32	0.00	0.01
Finland	FINDIET 2007	75.04	7.31	8.84	6.74	1.42	0.00	0.65
France	INCA2	58.46	11.50	18.52	9.23	2.21	0.00	0.07
Germany	National Nutrition Survey II	56.92	9.98	20.42	11.31	1.14	0.00	0.24
Hungary	National Repr Surv	13.28	22.41	36.02	21.28	6.85	0.00	0.17
Italy	INRAN SCAI 2005 06	63.04	14.96	10.43	8.87	2.63	0.00	0.08
Very elderly								
Belgium	Diet National 2004	55.21	10.81	14.11	18.21	1.59	0.01	0.06
Denmark	Danish Dietary Survey	62.87	10.56	13.18	11.87	1.51	0.00	0.01
France	INCA2	58.25	11.84	17.95	9.45	2.40	0.00	0.11
Germany	National Nutrition Survey II	59.84	9.15	17.60	12.17	1.03	0.00	0.20
Hungary	National Repr Surv	11.74	19.70	35.38	26.42	6.62	0.00	0.15
Italy	INRAN SCAI 2005 06	48.73	23.00	12.89	11.44	3.76	0.02	0.16

Legend: (a): "Infants" refer to foods for infants and young children. (b) "Other" gathers the other foods taken into account for the exposure assessment: honey, vitamin and mineral supplements and supplements containing special fatty acids.

✓ *NDL-PCB indicators*

Country	Survey acronym	Fish	Milk	Meat	Fat	Egg	Infants[(a)]	Other[(b)]
				Infants				
Bulgaria	NUTRICHILD	4.95	27.50	40.34	6.57	1.44	19.16	0.04
Italy	INRAN SCAI 2005 06	17.33	34.15	5.27	4.01	0.09	39.01	0.16
				Toddlers				
Belgium	Regional Flanders	20.59	43.53	24.74	7.87	0.00	3.25	0.02
Bulgaria	NUTRICHILD	14.92	19.62	55.44	6.52	2.09	1.27	0.15
Finland	DIPP	40.44	17.21	32.77	4.64	0.77	4.17	0.01
Germany	DONALD 2006	22.62	29.05	23.39	5.74	2.14	16.87	0.20
Germany	DONALD 2007	18.73	32.38	27.27	5.62	1.34	14.51	0.15
Germany	DONALD 2008	24.73	28.38	20.36	5.99	1.95	18.58	0.01
Italy	INRAN SCAI 2005 06	36.78	32.26	19.13	4.74	1.42	5.03	0.65
Netherlands	VCP kids	15.28	33.44	34.17	12.18	1.75	3.03	0.15
Spain	enKid	16.31	34.51	44.89	1.71	0.00	2.53	0.06
				Other children				
Belgium	Regional Flanders	30.21	36.07	24.40	7.51	0.01	1.66	0.14
Bulgaria	NUTRICHILD	18.50	16.40	56.26	6.38	2.13	0.09	0.25
Czech Republic	SISP04	34.17	14.92	39.41	8.80	2.19	0.11	0.40
Denmark	Danish Dietary Survey	26.71	19.74	35.73	15.99	1.81	0.00	0.02
Finland	DIPP	35.81	18.38	34.29	9.66	1.72	0.07	0.08
Finland	STRIP	37.52	17.79	35.27	7.79	0.69	0.18	0.76
France	INCA2	42.04	16.74	33.73	5.60	1.48	0.32	0.08
Germany	DONALD 2006	27.78	24.87	35.40	7.48	2.61	1.30	0.56
Germany	DONALD 2007	25.54	27.45	35.76	7.22	2.82	0.75	0.47
Germany	DONALD 2008	29.73	25.28	34.63	6.63	2.60	0.61	0.53
Greece	Regional Crete	30.85	41.04	23.12	2.60	1.61	0.25	0.53
Italy	INRAN SCAI 2005 06	50.77	17.85	24.20	4.77	1.90	0.31	0.20
Latvia	EFSA TEST	27.44	18.83	46.33	6.02	1.23	0.00	0.16
Netherlands	VCP kids	22.18	28.83	33.57	12.32	1.87	1.11	0.13
Spain	enKid	30.18	20.71	45.83	3.01	0.02	0.15	0.09
Spain	NUT INK05	43.27	18.20	36.14	2.23	0.00	0.00	0.16
Sweden	NFA	34.50	22.35	35.36	6.28	0.69	0.58	0.23
				Adolescent				
Belgium	Diet National 2004	31.34	19.89	37.33	9.32	1.93	0.04	0.15
Cyprus	Childhealth	44.96	20.10	32.02	2.24	0.41	0.01	0.26
Czech Republic	SISP04	33.76	13.48	40.59	9.66	2.21	0.04	0.26
Denmark	Danish Dietary Survey	25.31	19.23	40.01	13.65	1.79	0.00	0.02
France	INCA2	39.20	14.59	39.61	5.06	1.44	0.00	0.09
Germany	National Nutrition Survey II	18.11	20.17	50.27	10.48	0.65	0.00	0.31
Italy	INRAN SCAI 2005 06	52.26	17.68	23.31	4.97	1.70	0.01	0.06
Latvia	EFSA TEST	18.84	19.02	52.61	7.79	1.56	0.00	0.18
Spain	AESAN FIAB	32.26	13.02	47.31	4.92	2.44	0.00	0.07
Spain	enKid	40.14	12.52	44.35	2.84	0.01	0.01	0.13
Spain	NUT INK05	41.54	14.58	40.91	2.87	0.00	0.00	0.10
Sweden	NFA	37.58	19.26	37.26	5.24	0.50	0.00	0.16
				Adult				
Belgium	Diet National 2004	43.42	16.06	29.01	9.78	1.51	0.02	0.20
Czech Republic	SISP04	33.17	11.01	45.54	8.17	1.89	0.01	0.22

Country	Survey acronym	Fish	Milk	Meat	Fat	Egg	Infants[(a)]	Other[(b)]
Denmark	Danish Dietary Survey	35.91	15.48	34.28	12.66	1.65	0.00	0.02
Finland	FINDIET 2007	48.98	13.10	27.18	8.60	1.43	0.00	0.72
France	INCA2	44.36	13.40	35.45	5.22	1.39	0.00	0.18
Germany	National Nutrition Survey II	36.76	14.91	38.78	8.16	0.91	0.00	0.49
Hungary	National Repr Surv	13.89	16.31	56.23	9.35	3.84	0.00	0.38
Ireland	NSIFCS	25.10	14.65	49.00	9.44	1.24	0.00	0.58
Italy	INRAN SCAI 2005 06	58.83	14.82	20.03	4.66	1.49	0.00	0.15
Latvia	EFSA TEST	42.61	12.10	39.14	4.92	1.02	0.00	0.22
Netherlands	DNFCS 2003	21.81	23.63	43.11	10.47	0.79	0.02	0.18
Spain	AESAN	51.95	11.09	30.63	4.22	2.07	0.00	0.04
Spain	AESAN FIAB	49.75	10.13	33.32	4.51	2.18	0.00	0.10
Sweden	Riksmaten 1997 98	52.32	16.02	24.23	5.85	1.47	0.00	0.10
United Kingdom	NDNS	40.46	14.32	37.62	4.99	2.25	0.02	0.35
				Elderly				
Belgium	Diet National 2004	54.38	11.28	20.68	12.41	0.96	0.00	0.28
Denmark	Danish Dietary Survey	49.16	12.81	24.78	11.63	1.60	0.00	0.03
Finland	FINDIET 2007	65.41	8.24	17.05	7.24	1.11	0.00	0.95
France	INCA2	50.98	12.57	28.46	6.25	1.49	0.00	0.25
Germany	National Nutrition Survey II	47.55	12.23	30.41	8.23	0.78	0.00	0.80
Hungary	National Repr Surv	9.08	19.29	56.79	10.41	3.96	0.00	0.48
Italy	INRAN SCAI 2005 06	57.94	15.04	20.04	5.16	1.62	0.00	0.21
				Very elderly				
Belgium	Diet National 2004	52.96	11.15	20.57	14.09	1.01	0.01	0.20
Denmark	Danish Dietary Survey	60.87	10.44	18.33	9.36	0.97	0.00	0.03
France	INCA2	49.89	13.10	28.14	6.83	1.65	0.00	0.38
Germany	National Nutrition Survey II	50.68	11.89	27.02	8.94	0.74	0.00	0.73
Hungary	National Repr Surv	8.18	17.49	57.67	12.17	4.05	0.00	0.45
Italy	INRAN SCAI 2005 06	41.87	22.83	26.12	6.47	2.26	0.02	0.43

Legend: (a): “Infants” refer to foods for infants and young children. (b) “Other” gathers the other foods taken into account for the exposure assessment: honey, vitamin and mineral supplements and supplements containing special fatty acids.

GLOSSARY AND ABBREVIATIONS

µg/kg	Microgram per kilogram
1,2,3,4,6,7,8-HpCDD	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin
1,2,3,4,6,7,8-HpCDF	1,2,3,4,6,7,8-Heptachlorodibenzofuran
1,2,3,4,7,8,9-HpCDF	1,2,3,4,7,8,9-Heptachlorodibenzofuran
1,2,3,4,7,8-HxCDD	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin
1,2,3,4,7,8-HxCDF	1,2,3,4,7,8-Hexachlorodibenzofuran
1,2,3,6,7,8-HxCDD	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin
1,2,3,6,7,8-HxCDF	1,2,3,6,7,8-Hexachlorodibenzofuran
1,2,3,7,8,9-HxCDD	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin
1,2,3,7,8,9-HxCDF	1,2,3,7,8,9-Hexachlorodibenzofuran
1,2,3,7,8-PeCDD	1,2,3,7,8-Pentachlorodibenzo-p-dioxin
1,2,3,7,8-PeCDF	1,2,3,7,8-Pentachlorodibenzofuran
2,3,4,6,7,8-HxCDF	2,3,4,6,7,8-Hexachlorodibenzofuran
2,3,4,7,8-PeCDF	2,3,4,7,8-Pentachlorodibenzofuran
2,3,7,8-TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
2,3,7,8-TCDF	2,3,7,8-Tetrachlorodibenzofuran
Ah	Aryl hydrocarbon
AL	Action level
b.w.	Body weight
CONTAM	EFSA Panel on Contaminants in the Food Chain
DL-PCB	Dioxins like-PCB
d.w.	Dry weight
EC	European Community
EFSA	European Food Safety Authority
EPA	Environmental Protection Agency
EU	European Union
GC/ECD	Gas chromatography in combination with an electron capture detector
GC/HRMS	Gas chromatography in combination with high-resolution mass spectrometry
GC/MS	Gas chromatography in combination with mass spectrometry
HRGC/HRMS	High-resolution gas chromatography in combination with high-resolution mass spectrometry
IARC	International Agency for Research on Cancer
l.w.	Fat weight (lipid weight)
LB	Lower bound
LOD	Limit of detection
LOQ	Limit of quantification
MB	Middle bound
ML	Maximum level

NDL-PCB	Non dioxins like-PCB
ng/g	Nanogram per gram
ng/kg	Nanogram per kilogram
OCDD	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin
OCDF	1,2,3,4,6,7,8,9-Octachlorodibenzofuran
PCB	Polychlorinated Biphenyl
PCB-101	2,2’,4,5,5’-Pentachlorobiphenyl
PCB-105	2,3,3',4,4'-Pentachlorobiphenyl
PCB-114	2,3,4,4',5- Pentachlorobiphenyl
PCB-118	2,3',4,4',5- Pentachlorobiphenyl
PCB-123	2',3,4,4',5- Pentachlorobiphenyl
PCB-126	3,3',4,4',5-Pentachlorobiphenyl
PCB-138	2,2’,3,4,4’,5’-Hexachlorobiphenyl
PCB-153	2,2’,4,4’,5,5’-Hexachlorobiphenyl
PCB-156	2,3,3',4,4',5- Hexachlorobiphenyl
PCB-157	2,3,3',4,4',5'- Hexachlorobiphenyl
PCB-167	2,3',4,4',5,5'- Hexachlorobiphenyl
PCB-169	3,3',4,4',5,5'-Hexachlorobiphenyl
PCB-180	2,2’,3,4,4’,5,5’-Heptachlorobiphenyl
PCB-189	2,3,3',4,4',5,5'-Heptachlorobiphenyl
PCB-28	2,4,4’-Trichlorobiphenyl
PCB-52	2,2’,5,5’-Tetrachlorobiphenyl
PCB-77	3,3',4,4'-Tetrachlorobiphenyl
PCB-81	3,4,4',5-Tetrachlorobiphenyl
PCDD	Polychlorinated dibenzo-p-dioxins
PCDD/F	Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans
PCDF	Polychlorinated dibenzo-p-furans
pg/g	Picogram per gram
SCF	Scientific Committee on Food
SSD	Standard Sample Description
TEF	Toxicity equivalency factor
TEQ	Toxicity equivalents
TWI	Tolerable Weekly Intake
UB	Upper bound
w.w.	Whole weight
WHO	World Health Organization