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EU maximum levels for dioxins and dioxin-like PCBs

- Impact on exposure and food supply in the Nordic countries

Marie Louise Wiborg, Norway

Helle Katrine Knutsen, Norway

Östen Andersson, Sweden

Arne Büchert, Denmark

Tommy Cederberg, Denmark

Per Ola Darnerud, Sweden

Anja Hallikainen, Finland

Hannu Kiviranta, Finland

Kristín Ólafsdóttir, Iceland

Kim Petersen, Denmark

Liisa Rajakangas, Finland

Are Sletta, Norway

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Nordic Council of Ministers
Store Strandstræde 18
DK-1255 Copenhagen K
Phone (+45) 3396 0200
Fax (+45) 3396 0202

Nordic Council
Store Strandstræde 18
DK-1255 Copenhagen K
Phone (+45) 3396 0400
Fax (+45) 3311 1870

www.norden.org

Nordic co-operation

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Content

Preface

The following project group has worked out this report:

Denmark

Arne Büchert, Department of Food Chemistry, National Food Institute, Technical University of Denmark
Tommy Cederberg, Department of Food Chemistry, National Food Institute, Technical University of Denmark
Kim Petersen, Danish Food and veterinary Administration

Finland

Anja Hallikainen, Finnish Food Safety Authority (EVIRA)
Hannu Kiviranta, Department of Environmental Health, National Public Health Institute (KTL)
Liisa Rajakangas, Trade Department, Ministry of Trade and Industry

Iceland

Kristín Ólafsdóttir, Department of Pharmacology and Toxicology, University of Iceland

Norway

Marie Louise Wiborg (project manager), Norwegian Scientific Committee for Food Safety (VKM)
Helle Katrine Knutsen, National Institute of Public Health
Are Sletta, Norwegian Food Safety Authority

Sweden

Per Ola Darnerud, Research and Development Department, National Food Administration
Östen Andersson, National Food Administration

The project group decided that a report was the best way to summaries the outcome of the work. The report contains data on dioxins and dioxin-like PCBs in food, comparison of dietary intake calculations in the Nordic countries, views and discussions on different ways of setting maximum levels in food with impact on food supply and exposure. The report contains also some recommendations from the project group for use in the upcoming discussions when EU shall review maximum levels for dioxins and dioxin-like PCBs in foodstuffs. The project group hopes that this report will be of interest for those who work with food safety aspects in the Nordic countries as well as in other countries in Europe.

"The Nordic group" refers in this report to the people who have been involved in the project. The conclusions are not necessarily the official view of the Nordic authorities. However, the conclusions and recommendations reflect the discussion in the project group, and the work on dioxins and dioxins-like PCBs carried out in the Nordic countries.

Summary

The project “Review of maximum levels for dioxins and dioxin-like PCBs, impact on the consumer exposure and the food supply”, coordinated by Norway, is one of three projects on dioxins and dioxin-like PCBs that were initiated in 2003/2004 and financed by the Nordic Council of Ministers.

Aims of the present project:

- To compile and discuss results from national monitoring programs and other projects carried out in the Nordic countries concerning dioxins and dioxin-like PCBs in food.
- To compile dietary exposure estimates on dioxins and dioxin-like PCBs in Nordic countries.
- To discuss impact on the food supply with different maximum levels for dioxins and dioxin-like PCBs and evaluate exposure from food when different sets of maximum levels for dioxins and dioxin-like PCBs are applied.
- To discuss and if possible conclude on recommendation for a mutual Nordic view to be used in the ongoing negotiations on dioxins and dioxin-like PCBs in EU.

The report summarize how the dioxin risk was previously assessed and handled in the Nordic countries, together with data on dioxins and dioxin-like PCBs in food, a comparison of dietary exposure in the Nordic countries, and discussions of impact of lower maximum levels on exposure and food supply. The report also contains recommendations for the upcoming discussions when EU shall review maximum levels (MLs) for dioxins and dioxin-like PCBs in food.

This report reflects the discussions the Nordic group had during their meetings. The conclusions and recommendations are not necessarily the official view in the Nordic countries.

The project group has discussed the impact on food supply in the Nordic countries if current MLs for dioxins and dioxin-like PCBs are reduced with 25%, based on Nordic occurrence data presented in the report. The 25% was chosen since a reduction of this size was pointed out in earlier EU documents. The work with this Nordic task has shown that lowering MLs with 25% for dioxins and dioxin-like PCBs for all food categories in the EU legislation would just have minor, if any, impact on food supply or exposure. Additionally, some lower contamination levels, within the range of realistic occurrence levels, have been used in theoretical intake estimates.

It should be kept in mind that the conclusions of the work are based on a limited database for which reason the estimation of levels in food might change when more data are provided through the monitoring programmes. The Nordic group does not believe that MLs is the only tool that can and should be used to reduce the exposure levels in the Nordic countries. When MLs in EU are being set, all Member States have to be heard, and different countries in EU have different contaminant levels found in their food. The most contaminated food group in one country might be different in other countries. The result in the EU negotiation is that MLs are set at a level that excludes only the most contaminated food from the market. The project group is of the opinion that the use of substantially lower action levels than the existing ones could be an important tool to reduce exposure in the Nordic population.

As an overall conclusion the Nordic group is in favour of considering the “as low as reasonably achievable” (ALARA) principles when setting MLs. The application of ALARA is stated in the EU Regulation, and this principle is also one of the most important tools to avoid contaminated food to enter the EU market. Since the MLs are in most cases above the actual levels found in food in the Nordic countries, it can be deduced that EU’s MLs are not in accordance with the ALARA principles for most foodstuffs from the Nordic countries.

It is difficult to communicate that consumption advices are necessary on certain food product, even though the levels of dioxins and DL-PCBs are below the MLs. Another concern among the Nordic countries, when MLs are set much higher than necessary, is that food from abroad with an elevated level of dioxins and dioxin-like PCBs could enter the Nordic market legally, and then lead to a higher exposure in the population (e.g marine oils).

For farmed fish and in domestic animals the levels found reflect the levels in the feed and to a less extent in the environment. As a consequence, the most efficient way of lowering levels in those food groups is to regulate and lower the levels in feed.

The Nordic group did not reach a final conclusion on how the current ML for wild and farmed fish could be differentiated or reduced to a level, which is in better accordance with the levels found in the monitoring programmes. The discussion of this important question is referred in the report.

Another conclusion from the Nordic group is that it is still important to reduce the dietary exposure levels for dioxins and dioxin-like PCBs in the Nordic countries, at least among some subgroups in the population. The project group has noted that all the Nordic countries have communicated consumption advices to their populations. However, it could always be questioned how effective such advices are. If MLs in EU are kept too high, there might be a need to extend the consumption advises in the Nordic countries, which again could complicate risk communication.

Recommendations

- Substantially lower action levels set on national or regional basis could be a better tool than EU MLs to reduce exposure.
- The system to report levels exceeding the action levels and action taken should be improved
- ALARA principle should be considered when setting MLs for dioxins and dioxin-like PCBs.
- For farmed fish and domestic animals it is most important to control the levels in feed.
- ML for eel should be reduced substantially and treated as other fish.
- Marine oil for human consumption should be refined with best available technology (BAT) and the ML should be reduced substantially.
- Monitoring of dioxins and PCBs in food and feed should be continued. This improves the knowledge and focus on levels in food, which can be used in intake calculations. Database with monitoring information should be made available to Member States.
- More extensive data on food consumption habits in the Nordic countries, preferably obtained in a harmonised way, is crucial for better estimates on intake in the Nordic countries.
- Improved monitoring of levels in human blood or milk should be carried out in order to follow the time trends of human exposure.

1. Introduction

Maximum levels (MLs) for dioxins in foodstuff were laid down in 2001 by the European Union (Council Regulation (EC) No 2375/2001, now replaced by Commission Regulation (EC) No 1881/2006). The discussion about setting the MLs had been going on in EU since 1999 when high levels of dioxins and PCBs were discovered in meat from domestic animals from Belgium – the so-called Belgian dioxin crisis (Ashraf, 1999; Erickson, 1999; Bernard & Fierens, 2002; Bernard *et al.*, 2002). The MLs were set to prevent unacceptably high exposure levels among the human population and the distribution of foodstuffs with an unacceptably high contamination.

For several reasons the adoption of this EU Regulation puts dioxins back on the political agenda in the Nordic countries. It has been known for years that The Baltic Sea is heavely polluted with persistent organic contaminants like dioxins and PCBs (Ahlborg *et al.*, 1992), and it is also well known that oily fishes like salmon and herring from the Baltic Sea have higher contamination levels of dioxins and PCBs than the same species from other catching areas. Finland and Sweden have handled this problem nationally with consumption advices etc. This was however a very difficult issue when the premises for the regulation for dioxin was discussed in EU. Furthermore, it was also a major concern in the Nordic countries that several of the MLs for dioxins in different food commodities where much higher than levels actually found in the food. Could these high MLs lead to an increased exposure to dioxins in the population? At the same time, the announced inclusion of dioxin-like PCBs (DL-PCBs) into the regulation made some concerns as well. DL-PCBs are sometimes found at higher concentrations than dioxins in the Nordic environment (Ahlborg *et al.*, 1992; SCOOP, 2000), especially in fish and fishery products. Could maximum levels for DL-PCBs cause problems for the consumers and the fish industries in the Nordic countries?

The Nordic Council of Ministers agreed in 2002 to establish a Nordic cooperation for dioxins and dioxin-like PCBs, partly to fulfil the statement in the Greenland declaration (Nordisk Ministerråd, 2002) to establish a Nordic platform in internationally forums and partly to follow up on the recommendations from the Nordic Council on food safety aspects for dioxins and dioxin-like PCBs.

The project "Review of maximum levels for dioxins and dioxin-like PCBs, impact on the consumer exposure and the food supply", coordinated by Norway, is one of three projects on dioxins and DL-PCB sthat were initiated in 2003/2004 and financed by the Nordic Council of Ministers. The two other projects "Dioxin and DL-PCBs in the Nordic countries – intersectorial network for coordination of actions", coordinated by Sweden and "Harmonizing methods for sampling, sample preparation, co-ordination of investigations and method development of dioxins and DL-PCBs in food", coordinated by Denmark have been reported separately.

Aims of the present project:

- To compile and discuss results from national monitoring programs and other projects carried out in the Nordic countries concerning dioxins and DL-PCBs in food.
- To compile dietary exposure estimates on dioxins and DL-PCBs in Nordic countries.
- To discuss impact on the food supply with different maximum levels for dioxins and DL-PCBs and evaluate exposure when different sets of maximum levels for dioxins and DL-PCBs are applied.
- To discuss and if possible conclude on recommendation for a mutual Nordic view to be used in the ongoing negotiations on dioxins and DL-PCBs in EU.

The time schedule in EU for setting and revising MLs has been postponed several times. The MLs for DL-PCBs were first included in the regulation in 2006, and the MLs will not be revised before the end of 2008. In the latest documents there is not stated a fixed figure for the reduction of MLs, but it is stated that they should be reduced if possible. However, the overall goal of setting MLs for dioxins and DL-PCBs in EU is still valid and the changes of time schedule have therefore not interfered much with the aims of this Nordic project. The project was initially set up for the period from 2004 to end of 2006. The final date for this project has been postponed to end of July 2007.

2. Background

2.1. Dioxins and dioxin-like PCBs

Dioxins and polychlorinated biphenyls (PCBs) refer to closely related groups of chlorinated organic compounds. Dioxins and PCBs are fat-soluble and persistent, they bioaccumulate and are biomagnified in the environment. They are found in the highest concentrations in organisms located high in the food chain. Included in these are the most toxic 2,3,7,8-TCDD and 1,2,3,7,8 penta-CDD. Of the 210 possible dioxins congeners (PCDDs and PCDFs) 17 2,3,7,8-substituted congeners are regarded as especially toxic. Altogether there are 209 different PCB congeners. The chemical properties and toxic effects of these individual substances vary according to the number and position of the chlorines on the phenyl rings. Twelve of the 209 PCB congeners are included in the group of dioxin-like PCBs. The rest are referred to as non-dioxin-like PCBs. Non-dioxin-like PCBs were recently assessed by EFSA's Scientific Panel on Contaminants in the Food Chain (EFSA, 2005). As with dioxin-like PCBs, non-dioxin-like PCBs bioaccumulate to varying degrees and may trigger a number of toxic effects.

The most significant health-damaging effects of dioxins and DL-PCBs from chronic exposure are impairment of the reproductive system, a weakened immune response, neurotoxic effects, impairment of the endocrine system and carcinogenic effects. 2,3,7,8-TCDD has been classified as a human carcinogen (Group 1) by IARC (IARC, 1997). Several epidemiological studies have shown that there is an increased risk of cancer associated with dioxin exposure, but these studies do not give consistent results regarding the specific organs affected. Dioxins are carcinogenic in laboratory animals and cause for instance liver cancer in rats (IARC, 1997). Dioxins are non-genotoxic, and it is believed that the carcinogenic effect occurs above a dose threshold (JECFA, 2001; SCF, 2001).

The effects of long-term exposure to low amounts of dioxins appear to be related to the binding of dioxin-like compounds to a specific intracellular receptor protein (Ah receptor (aryl hydrocarbon), also known as a TCDD or dioxin receptor). This dioxin/protein complex is transported to the nucleus and affects a number of fundamental biochemical processes in the cells. The receptor-mediated effect is considered to have a dose threshold. The strength at which the different PCDD/Fs and DL-PCBs bind to the dioxin receptor varies and as a result, the different congeners also have different potencies. The most potent compound is 2,3,7,8-TCDD. A dose addition model for PCCD/Fs and DL-PCBs has been used. The toxicity of 17 dioxins and 12 DL-PCBs are expressed in terms of toxicity equivalency factors (TEF) in relation to TCDD. The total amount of toxicity equivalents (TEQ) in a sample is estimated by multiplying the content of each congener with the associated TEF and then summing up the contributions from the respective congeners. However, it should be noted that the amount of toxicity equivalents in a sample (TEQ_sum), which is a measure of the total toxicity of the dioxins, is a simplified method of assessing the risk of dioxin/PCB combinations.

Data from experiments on laboratory animals have been used for quantitative risk assessment. The effects on reproduction in rats appear to be the effect triggered at the lowest dose. Expert groups in Scientific Committee on Food (SCF) (SCF, 2001) and Joint Expert Committee on Food Additives and Contaminants (JECFA) (JECFA, 2001) have assessed the health risks associated with the intake of dioxins and dioxin-like PCBs, taking into account the large difference in biological half-life of TCDD in rats and humans (i.e. about one month versus 7.5 years), the lack of data, and limited knowledge about the variation in the biological half-lives of different population groups.

The tolerable intake established by SCF is 14 pg TEQ/kg bodyweight/week (SCF, 2001). JECFA's assessment is comparable with the EU's, except from that JECFA expresses the tolerable intake level on a monthly basis (70 pg TEQ/kg bodyweight/month) (JECFA, 2001).

2.2. History of risk assessment and risk management of dioxins and PCBs in the Nordic countries

Scientist and authorities in the Nordic countries have been working with dioxins and PCBs for many years. In 1966 a Swedish scientist identified PCBs in human and wildlife samples (Jensen, 1966). This discovery made the authorities aware of the fact that PCBs could be found in the food as well as in the human body, which again lead to an increasing concern. Did environmental contaminants like PCBs in human tissues have negative effects on human health?

In 1987-1988 "Statens Miljömedicinska Laboratorium", SML in Sweden carried out a risk assessment on dioxins with a Nordic reference group (Ahlborg *et al.*, 1988). The risk assessment established a tolerable weekly intake (TWI) of 0-35 pg TCDD/kg body weight (bw). The TWI for TCDD was considered valuable for other dioxins and furans as well, when calculated to TEQ. TEFs were established for relevant dioxins and furans. The group pointed out that consumption of fish could be an important source of human exposure, depending up on species and location. People consuming herring from the Baltic Sea could exceed the TWI with a factor of 2-3. Authorities in Finland, Norway and Sweden used this risk assessment to give consumption advices to the public. The advices were mainly to avoid eating too much or not eat at all the fish from certain areas with high contamination levels, like some parts of the Baltic Sea (Sweden, Finland) and the Grenlandsfjord, Norway (Økland, 2005).

In 1992 a risk assessment of polychlorinated biphenyls (PCBs) was carried out at Karolinska Institute, Stockholm in cooperation with the Nordic expert group (Ahlborg *et al.*, 1992). The expert group concluded that it is not possible to give a tolerable intake level for the sum of PCBs or for the individual congeners. Furthermore, the group stated that some PCBs have dioxin-like properties, and they suggested TEFs for some non-*ortho* PCBs and mono-*ortho* PCBs. The group concluded that the risks related to PCB contamination probably were higher than the risks related to dioxin exposure. Consumption of fish from some polluted areas could lead to an intake above TWI for dioxins if contribution from DL-PCBs were included. Based on this new evaluation, further restrictions/advises were given by the authorities in some of the Nordic countries (Darnerud *et al.*, 1995; NFA, 1995; Wicklund-Glynn *et al.*, 1996).

A few years later, a toxicological re-evaluation of PCBs was made by the Nordic toxicology group and it was decided to maintain the Nordic TEFs and DL-PCBs should be included in the Nordic TWI (Ahlborg *et al.*, 1995)

In 1999 the Nordic expert group met again in Stockholm to discuss the World Health Organization (WHO) risk assessment of dioxins from 1998 (WHO, 1998). WHO had introduced body burden as the basis for the calculation of tolerable intake and the Nordic group support this new approach for the risk assessment of dioxins and PCBs. The new TEFs for calculation of TEQ was discussed and recommended as new values to be used in the Nordic countries as well. The Nordic group did not adopt the new WHO tolerable daily intake (WHO-TDI) from 1-4 pg TEQ/kg bw/day, mainly because there where some uncertainties in the WHO-evaluation. The Nordic group also concluded that a daily intake of 4 pg TEQ/kg bw (or a weekly intake of 28 pg TEQ/kg bw) were not very different from the Nordic TDI of 5 pg TEQ/kg bw/day (or 35 pg TEQ/kg bw/week). It is worth mentioning that WHO were using 10 pg TEQ/kg bw/day as a TDI-value for dioxins before 1998, whereas the Nordic countries had used 5 pg TEQ/kg bw/day since 1988. Dietary intake calculation in the Nordic countries showed that an average consumer was exposed to approximately half of the Nordic TWI from food. However, some population groups in the Nordic countries were at risk due to high consumption of seafood with high contamination levels (Becher *et al.*, 1997; SCOOP, 2000).

On May 30, 2001 the SCF adopted an opinion based on new scientific information on "the Risk assessment of dioxins and DL-PCBs in food". A TWI for dioxins and DL-PCBs of 14 pg WHO-TEQ/kg bw was established. This TWI has been used in the Nordic countries since 2001. However, the new TWI gave the authorities some challenges as the average dietary exposure was at the same level as the new TWI (SCOOP, 2000).

Large groups in the population would therefore exceed TWI. New and more restrictive consumption advices were given, especially to vulnerable groups like children and young females at reproductive age. A summary of Nordic consumption advices, given to reduce dietary exposure to dioxins and DL-PCBs, is given in chapter 4.

In 2005 some of the TEF values for congeners of chlorinated dibenzo-*p*-dioxins, chlorinated dibenzofurans, non-*ortho* substituted PCBs (no-PCBs) and mono-*ortho* substituted PCBs were either increased, decreased or kept unchanged (Van den Berg *et al.*, 2006). Of the 17 chlorinated dioxins and furans (termed dioxins) with an assigned TEF-value, two were increased and two were decreased. Of the mono-*ortho* PCBs all except one of the TEF-values were reduced. However, two of the four non-*ortho* PCBs have three-fold higher TEFs after the revision. The impact of the new TEFs on total TEQ in the diet remains to be calculated in the Nordic countries. However, in the article presenting new TEFs (Van den Berg *et al.*, 2006) TEQ calculations from some biotic samples were made with both the old and the new TEF factors, and generally a decrease ranging between 10-25% was seen with the new set of TEFs.

It is generally agreed that the foetal period is the most sensitive life stage, and the currently accepted tolerable weekly or monthly intakes of dioxin (TWI/TMI) are based on toxic effects observed in offspring of female rats that were exposed during pregnancy. These intake limits are thus mainly valid for girls and women that are in child-bearing age, while they are less relevant for other groups. Therefore, a Swedish risk assessment was recently performed to estimate the tolerable intake of PCDD/DF and DL-PCBs among humans that will not undergo a pregnancy, i.e. boys, men and post-menopausal women (Hanberg *et al.*, 2007).

According to this report, the currently available toxicological literature on non-developmental TCDD exposure suggests that cancer is the most sensitive adverse effect of chronic exposure. In life-long cancer studies in rats and mice, the NOAEL level for increased tumour risk was 540-2000 pg/g lipid, compared to approximately 30 pg/g for reproductive effects in rat offspring exposed during foetal development. By assuming a 80% intestinal absorption efficiency and using benchmark modelling to estimate the dose to give a 5% increase in cancer frequency in a rat study, a (BMDL05) dose of 1500 pg TCDD/g lipid was obtained, corresponding to an estimated human daily intake of 95 pg TCDD/kg body weight (Hanberg *et al.*, 2007).

Using different assessment factors (x3.2, x10, x50), three scenarios with different degrees of health margin were calculated (in scenario I the factor 3.2 was used, as was earlier used in calculation of the present tolerable maximum intake calculations by JECFA and WHO, whereas in scenario II and III, the assessment factor of 10 and 10x5 was used, the latter factor 5 used to account for the seriousness of the cancer effect). Thus, the final TDI according to these assessment factors was in the range of 2-30 pg TCDD/kg body wt./day, and the report concludes that based on current scientific knowledge, a TDI range of 2-10 pg TEQ/kg bw/day represents exposure levels where human cancer risks are very low or non-existing (Hanberg *et al.*, 2007).

2.3. Regulation of dioxins and dioxin-like PCBs in food

In 2001 European Commission published an integrated and systematic strategy in order to secure better protection of human health and of the environment from the effects of dioxins and PCBs (COM (2001) 593 final). In the short-term the objective was to reduce human exposure to dioxins and PCBs, while the objective in the medium to long term was to maintain human exposure at safe levels. As a consequence, human intake levels should be reduced below the TWI of 14 pg WHO-TEQ per kg bw per week and in addition environmental effects from dioxins and PCBs would be reduced.

Table 1: Overview of documents published in EU in relation to the regulation of dioxins and DL-PCBs in food.

EU Number ***Publication date***	**Title**	**Content/Comments**
COM(2001) 593 final *24 October 2001*	Communication from the Commission to The Council, The European Parliament, and The Economic and Social Committee. Community Strategy for Dioxins, Furans and Polychlorinated Biphenyls.	Contain the strategy from the European Commission to reduce dioxins and PCBs in food, feed, environment and consequently the human exposure.
Commission Recommendation 2006/88/EC *6 February 2006*	The reduction of the presence of dioxins, furans and PCBs in feedingstuffs and foodstuffs.	The EUs strategy to reduce levels of dioxins and PCBs in food and feed with Action Levels and Target Levels. Replace Recommendation 2002/201/EC.
Commission Recommendation 2006/794/EC *16 November 2006*	The monitoring of background levels of dioxins, dioxin-like PCBs and non-dioxin-like PCBs in foodstuffs.	Monitoring program for background levels is expanded to 2000 food samples analyzed each year in Europe. Replace Recommendation 2004/705/EC.
Commission Regulation (EC) No 1881/2006 *19 December 2006* **Shall apply from March 2007**	Setting maximum levels for certain contaminants in foodstuffs	MLs for certain contaminants in foodstuffs. Replace Commission Regulation (EC) No 466/2001 with amendment (Council Regulation (EC) No 2375/2001 and Commission Regulation (EC) No 199/2006).
Commission Regulation (EC) No 1883/2006 *19 December 2006* **Shall apply from March 2007**	Laying down methods of sampling and analysis for the official control of levels of dioxins and dioxin-like PCBs in certain foodstuffs.	Contain methods for sampling procedures and analysis for dioxins and PCBs. Replace Directive 2002/69/EC.

When EU was working with the regulation of dioxins and DL-PCBs in food it was suggested to do this by an integrated approach. To reduce levels in foods and exposure in the European population it was decided to use maximum levels (MLs), action levels and target levels in addition to monitoring. The monitoring programme that was put in place was crucial for getting a better understanding of the levels of dioxins and DL-PCBs found in food commodities in Europe. In order to reduce levels in food it was clear that levels in feed also had to be regulated. Feed is not included in the aim of this Nordic task and the regulation of feed will not be described further in this chapter.

Several documents which are related to the regulation of dioxins and DL-PCBs in food have been published in EU since 2001. Table 1 gives an overview of some of the most important documents. Several of the original documents have been replaced lately for inclusion of new relevant information. For historical reasons some of the old documents are mentioned here.

2.3.1. Maximum levels for dioxins and dioxin-like PCBs in food in EU

In EU the basic principles of legislation on contaminants in food are found in Council Regulation (EEC) No 315/93 of 8 February 1993. The regulation says:

> "Food containing a contaminant in an amount which is unacceptable from a public health of viewpoint and in particular at a toxicological level shall not be placed on the market", furthermore "Contaminant levels shall be kept as low as can reasonably be achieved by following good practice at all stages of production of such food" and "Maximum levels must be set for certain contaminants in order to protect public health".

Maximum levels for certain contaminants in food are specified in Commission Regulation (EC) No 1881/2006. This regulation entered into force on 1 March 2007 and was replacing Commission Regulation (EC) No 466/2001. Maximum levels in certain foods are set for the following contaminants: nitrate, mycotoxins (aflatoxins, ochratoxin A, patulin, deoxynivalenol, zearalenone, fumonisins, T'-2 and HT-2-toxin), metals (lead, cadmium, mercury, and inorganic tin), 3-MCPD, dioxins and DL-PCBs and polycyclic aromatic hydrocarbons (benzo[a]pyrene). Levels for dioxins and DL-PCBs are given in Table 2.

It is stated in the Commission Regulation (EC) No 1881/2006 that

> "maximum levels should be set at a strict level which is reasonably achievable by following good agricultural, fishery and manufacturing practices and taking into account the risk related to the consumption of the food. In the case of contaminants which are considered to be genotoxic carcinogens or in cases where current exposure of the population or of vulnerable groups in the population is close to or exceeds the tolerable intake, maximum levels should be set at a level which is as low as reasonably achievable (ALARA). Such approaches ensure that food busi-

> ness operators apply measures to prevent and reduce the contamination as far as possible in order to protect public health. It is furthermore appropriate for the health protection of infants and young children, a vulnerable group, to establish the lowest maximum levels, which are achievable through a strict selection of the raw materials used for the manufacturing of foods for infants and young children"

It is further stated in the regulation:

> "From a toxicological point of view, any level set should apply to both dioxins and dioxin-like PCBs, but in 2001 maximum levels were set on Community level only for dioxins and not for dioxin-like PCBs, given the very limited data available at that time on the prevalence of dioxin-like PCBs. Since 2001, however, more data on the presence of DL-PCBs have become available; therefore, maximum levels for the sum of dioxins and DL-PCBs have been set in 2006 as this is the most appropriate approach from a toxicological point of view. In order to ensure a smooth transition, the levels for dioxins should continue to apply for a transitional period in addition to the levels for the sum of dioxins and dioxin-like PCBs. Foodstuffs must comply during that transitional period with the maximum levels for dioxins and with the maximum levels for the sum of dioxins and dioxin-like PCBs. Consideration will be given by 31 December 2008 to dispensing with the separate maximum levels for dioxins."

Table 2: Maximum levels (MLs) from the European Commission for dioxins and DL-PCBs in food. MLs for sum of dioxins and furans (WHO-PCDD/F-TEQ) where adopted in 2001. In 2006 MLs which includes sum of dioxins, furans and DL-PCBs (WHO-PCDD/F-PCB-TEQ) where adopted. All MLs are given in pg/g fat for all food categories excepted for fish and fishery product which are given in pg/g fresh weight.

	Foodstuffs	Maximum Levels	
		Sum of dioxins (WHO-PCDD/F-TEQ) [(a)]	Sum of dioxins and dioxin-like PCBs (WHO-PCDD/F-PCB-TEQ) [(a)]
1	Meat and meat products (excluding edible offal) of the following animals (b)		
	—bovine animals and sheep	3.0 pg/g fat[(c)]	4.5 pg/g fat[(c)]
	—poultry	2.0 pg/g fat [(c)]	4.0 pg/g fat[(c)]
	—pigs	1.0 pg/g fat [(c)]	1.5 pg/g fat[(c)]
2	Liver of terrestrial animals referred to in 1(b), and derived products thereof	6.0 pg/g fat [(c)]	12.0 pg/g fat[(c)]
3	Muscle meat of fish and fishery products and products thereof, excluding eel [(e), (f)] The maximum level applies to crustaceans, excluding the brown meat of crab	4.0 pg/g fresh weight	8.0 pg/g fresh weight
	and excluding head and thorax meat of lobster and similar large crustaceans (*Nephropidae* and *Palinuridae)* — Muscle meat of eel (*Anguilla anguilla)* and products thereof	4.0 pg/g fresh weight	12.0 pg/g fresh weight
4	Raw milk(g) and dairy products (g), including butter fat	3.0 pg/g fat[(c)]	6.0 pg/g fat[(c)]
5	Hen eggs and egg products (g)	3.0 pg/g fat[(c)]	6.0 pg/g fat [(c)]
6	Fat of the following animals:		
	- bovine animals and sheep	3.0 pg/g fat	4.5 pg/g fat
	- poultry	2.0 pg/g fat	4.0 pg/g fat
	- of pigs	1,0 pg/g fat	1,5 pg/g fat
7	-mixed animal fats	2,0 pg/g fat	3,0 pg/g fat
8	- Vegetable oil and fats	0.75 pg/g fat	1.5 pg/g fat
9	marine oil (fish body oil, fish liver oil and oils of other marine organisms intended for human consumption)	2.0 pg/g fat	10.0 pg/g fat,

[(a)]Upper bound concentrations: Upper bound concentrations are calculated on the assumption that all the values of the different congeners below the limit of quantification are equal to the limit of quantification.

[(b)]Foodstuffs listed in this category in Regulation (EC) No 853/2004 of the European Parliament and of the Council of 29. April 2004 laying down specific hygiene rules for food of animal origin OJ L 226, 25.6.2004, p. 22) (.

[(c)] The maximum level is not applicable for foods containing < 1 % fat.

[(d)]OJ L 209, 6.8.2002, p. 5. Directive as last amended by Directive 2004/44/EC (OJ L 113, 20.4.2004, p. 17).

[(e)]Where fish are intended to be eaten whole, the maximum level shall apply to the whole fish.

[(f)]Foodstuffs listed in this category as defined in categories (a), (b), (c), (d), (e) and (f) of the list in article 1 of regulation (EC) No 104/2000 with the exclusion of fish liver falling under code CN 0302 70 00.

[(g)]Foodstuffs listed in this category as defined in Regulation (EC) No 853/2004 of the European Parliament and of the Council of 29. April 2004 laying down specific hygiene rules for food of animal origin (O) L 226, 25.6.2004, p 22

The reduction of human dietary exposure to dioxins and DL-PCBs is important and necessary to ensure consumer protection. It is stated in regulation 1881/2006 that

> “A proactive approach is followed to actively reduce the dioxins and dioxin-like PCBs in feed and food and consequently the maximum levels applicable should be reviewed within a defined period of time with the objective to set lower levels. Therefore consideration will be given by 31 December 2008 at the latest to significantly reducing the maximum levels for the sum of dioxins and dioxin-like PCBs.

Operators need to make efforts to step up their capacity effectively to remove dioxins, furans and dioxin-like PCBs from marine oil. The significant lower level, to which consideration shall be given by 31 December 2008, shall be based on the technical possibilities of the most effective decontamination procedure.

As regarding the establishment of maximum levels for other foodstuffs by 31 December 2008, particular attention shall be paid to the need to set specific lower maximum levels for dioxins and dioxin-like PCBs in foods for infants and young children in the light of the monitoring data obtained through the 2005, 2006 and 2007 programmes for monitoring dioxins and dioxin-like PCBs in foods for infants and young children".

2.3.1.1. Derogation for Finland and Sweden for some fish species from the Baltic

When EU finalized the first regulation on dioxins in 2001 it was clear that the maximum levels for dioxins in fish would be much lower than the levels found in some of the fish species from the Baltic Sea. The solution, at that time, was that Finland and Sweden got a time limited derogation for fish from the Baltic region to be put on the domestic market until end of 2006 (Council Regulation (EC) No 2375/2001, now replaced by Commission Regulation (EC) No 1881/2006). However, the contamination levels in the Baltic Sea have not changed since 2001, and Finland and Sweden have now a temporary derogation to the last of December 2011, and is valid for the following fish species: salmon, herring, river lamprey, trout, char and roe of vendace (Commission Regulation (EC) No 1881/2006).

Finland and Sweden should, by 31 March each year, communicate to the Commission the results of their monitoring of levels of dioxins and DL-PCBs in fish obtained in the preceding year. The countries should also report on the measures taken to reduce human exposure to dioxins and DL-PCBs from fish from the Baltic region. Special attention should be taken for identified vulnerable population groups in order to avoid potential health risks.

2.3.1.2. National regulation in Denmark for some fish species from the Baltic

Denmark has not asked for any derogation for certain fish species from the Baltic. When the DL-PCBs were included in the legislation in 2006, Denmark decided to follow the EU-regulation by using the following domestic rules for trade of salmon and herring from the Baltic Sea:

All salmon intended for sale have to fulfil these rules, (salmons not intend for sale do not have to fulfil this legislation):

- No salmon larger than 5.5 kg (cleaned weight) must be put on the market.
- Salmons between 2.0 and 5.5 kg have to be trimmed before being placed on the market.

- Salmon larger than 5.5 kg have to be cut into two pieces before landing and coloured after landing.
- It is not legal to fish herring east of Bornholm.

2.3.2. Action levels and target levels

Commission recommendation 2006/88/EC on the reduction of the occurrence of dioxins, furans and PCBs in feedingstuffs and foodstuffs specifies action levels for dioxins and DL-PCBs in feed and food (Table 3). Action levels are considered as a tool for competent authorities to identify specific sources of contamination and take measures for their reduction or elimination. Action levels are typically set at 75% of the maximum levels. When member states find contamination levels in food that exceed the action levels, they shall investigate the source of contamination, take measures to reduce the contamination and also check for the presence of non-dioxin-like PCBs. Member states shall report these findings and the actions taken each year by 31 March.

It is further stated in the recommendation that:

> “the action levels should be periodically adjusted in line with the downward trend in dioxin and dioxin-like PCB presence and the active approach pursued to gradually reduce their presence in feedingstuffs and foodstuffs.”

Commission recommendation 2006/88 also defines target levels:

> “The target levels indicate the contamination levels to be achieved in feed and food in order to ultimately bring human exposure for the majority of the population of the Community down to the TWI for dioxins and dioxin-like PCBs set by the Scientific Committee for Food (SCF). They should be set in the light of more accurate information on the impact of environmental measures and the source directed measures at the level of feed and food on the reduction of the presence of dioxins and dioxin-like PCBs in the different feed materials, feedingstuffs and foodstuffs. Given that the determination of these target levels involves the consideration of many different factors, the setting of these target levels should be postponed to the end of 2008”.

Table 3 Action levels from the European Commission for dioxins and DL-PCBs in food. All action levels are given in pg/g fat for all food categories excepted for fish and fishery product which are given in pg/g fresh weight.

	Food	Action Levels	
		Action levels for dioxins + furans (WHO-TEQ) [(1)]	Action levels for dioxin-like PCBs (WHO-TEQ) [(1)]
1	Meat and meat products[(2)]		
	— of ruminants (bovine animals and sheep)	1.5 pg/g fat[(3)]	1.0 pg/g fat[(3)]
	— of poultry and farmed game	1.5 pg/g fat[(3)]	1.5 pg/g fat[(3)]
	— of pigs	0.6 pg/g fat[(3)]	0.5 pg/g fat[(3)]
	Liver and derived products of terrestrial animals	4.0 pg/g fat[(3)]	4.0 pg/g fat[(3)]
2	Muscle meat of fish and fishery products and products thereof, with the exception of eel [(5)(6)(7)]	3.0 pg/g fresh weight	3.0 pg /g fresh weight
	— Muscle meat of eel (*Anguilla anguilla)* and products thereof [(5)(6)(7)]	3.0 pg/g fresh weight	6,0 pg/g fresh weight
3	Milk[(8)] and milk products, including butter fat	2.0 pg/g fat[(3)]	2.0 pg/g fat[(3)]
4	Hen eggs and egg products[(h)]	2.0 pg/g fat[(3)]	2.0 pg/g fat [(3)]
5	Oils and fats		
	- Animal fat		
	-- of ruminants	1.5 pg/g fat	1.0 pg/g fat
	--of poultry and farmed game	1.5 pg/g fat	1.5 pg/g fat
	--of pigs	0.6 pg/g fat	0.5 pg/g fat
	--mixed animal fats	1.5 pg/g fat	0.75 pg /g fat
	- Vegetable oil and fats	0.5 pg/g fat	0.5 pg/g fat
	- Marine oil (fish body oil, fish liver oil and oils of other marine organisms intended for human consumption)	1.5 pg/g fat	6.0 pg/g fat
6	Fruits, vegetables and cereals	0.4 ng/kg product	0.2 ng/kg product

[(1)]Upper bound concentrations: Upper bound concentrations are calculated assuming that all the values of the different congeners less than the limit of quantification are equal to the limit of quantification.

[(2)]Meat of bovine animals, sheep, pig, poultry and farmed game as defined in Annex I to Regulation (EC) No 853/2004 of the European Parliament and of the Council of 29 April 2004 løaying down specific hygiene rules for food of animal origin (OJ L 139, 30.4.2004. Corrected version in OJ L 226, 25.6.2004, p. 22) but not including edible offal as defined in that Annex

[(3)]The action levels are not applicable for food products containing < 1 % fat.

[(4)]The target levels will be set by the end of the year 2008..

[(5)]Muscle meat of fish and fishery products as defined in categories (a), (b), (c), (e) and (f) of the list in Article 1 of Council Regulation (EC) No 104/2000 (OJ L 17, 21.1.2000, p. 22. Regulation as amended by the 2003 Act of Accession). The maximum level applies to crustaceans, excluding the brown meat of crab and excluding head and thorax meat of lobster and similar large crustaceans (*Nephropidae and Palinuridae)* and to cephalopods without viscera.

[(6)] Where the fish are intended to be eaten whole, the action level shall apply to the whole fish.

[(7)] When the action level is exceeded, it will be in some cases not necessary to perform an investigation as regards the source of contamination as the background level in some areas for some fish species is close to or exceeding the action level. However it is appropriate in these cases where the action level is exceeded to record all information such as sampling period, geographic origin and fish species in view of future measures as regards the presence of dioxins and dioxin-like compounds in fish and fishery products.

[(8)]Milk (raw milk, milk for manufacture of milk-based products and heat treated milk) as defined in Annex I to Regulation (EC) No 853/2004.

[(9)] Hen eggs and egg products as defined in Annex I to regulation (EC) No 853/2004.

2.3.3. Monitoring programme for dioxins and dioxin-like PCB in food

Along with the regulations setting maximum levels for dioxins in food, the member states of EU decided to carry out a monitoring program for dioxins and dioxin-like PCB in foodstuffs (Commission Recommendation 2006/794/EC). When the monitoring programme was started in 2002, around 1500 samples all together in EU, Iceland and Norway were to be analyzed yearly. The total number of samples each country should analyze was based on production statistics in EU. That means; countries with a large production of a particular food commodity should analyze more samples than countries with a smaller production. For most of the food categories the Nordic countries have a small production compared to huge food producing countries in Europe like France, Germany, Italy, Spain and UK. Therefore, the Nordic countries should just analyze a minimum of 3 samples for most of the food categories (except fish). After including new member states, the monitoring program has been extended to 2000 samples yearly (2006/794 EC).

It is quite costly to analyze dioxin and DL-PCBs in foodstuffs. The method used is time consuming and requires expensive instrumentation. For this reason the number of samples, which have been analyzed for dioxins and DL-PCBs are rather limited. However, around 2000 food samples analyzed each year in Europe will substantially increase the knowledge to the levels of dioxins and DL-PCBs in food commodities.

Sweden has reported results from the dioxin control programme to the Commission since 2003. This includes results from dioxin/dioxin-like PCB measurements of fish from the Baltic region, caught within the regular dioxin control programme, and in special surveillance projects. In total, about 100 fish samples have been analysed within the dioxin control programme 2003-2006, and about 160 samples were analysed as part of special surveillance projects. The analyses have primarily focused on oily fishes as salmon, trout and herring, where high levels could be suspected. In addition to reporting levels in fish, data on human intake of dioxin and DL-PCBs from food has been presented for adults and children, as well as questionnaire studies on consumer knowledge of the dietary recommendations on oily fish from the Baltic region.

Finland has reported results from the dioxin monitoring programme to the Commission since 2002. The reports include results for dioxins, DL-PCBs and other PCBs in fish from the Baltic region and inland lake fish, caught within the regular dioxin monitoring programme, or in special surveillance projects. In addition to fish, monitoring samples have included meat, liver, milk/cheese, egg, oil and fat, baby food, seal, and non-animal origin samples. Altogether 391 results of above mentioned analyte groups have been reported so far (last results from 2006). The number of results in different food groups is 282 fish, 33 meat, 5 liver, 18 milk/cheese, 16 egg, 7 oil and fat, 10 baby food, 2 seal, and 8 non-animal origin results.

In the annual report to the Commission measures according to environmental legislation and recommendations have been reported as well as reduction in emission levels and studies completed and/or published in relating to the environment. Results from scientific projects covering human health studies and fishing and hunting have also been referred. Measures taken to inform the general population about the levels of dioxins and PCBs in food including given fish consumptions advice in order to reduce the human exposure to these compounds have been explained to the Commission.

Denmark has reported results from dioxin monitoring programmes since 2000 to the Commission. The results have included dioxins and DL-PCBs as well as non dioxin-like PCBs. Up to 2003, results from approximately 250 samples have been reported. The samples include wild and farmed fish, cow milk, hen eggs and fat from chicken, hens, turkey, bovine, pigs and sheep.

3. Occurrence data and impact on food supply with lower MLs

The Nordic group decided to discuss the impact on food supply in the Nordic countries, based on available occurrence data assuming a reduction of the existing MLs with 25%. A reduction of this size was selected since it had been suggested in earlier EU documents. In the Commission Regulation (EC) No 1883/2006 a fixed figure for the reduction of the MLs is not stated, but the aim of the regulation is still to reduce the MLs for dioxins and DL-PCBs by the end of 2008.

It should be kept in mind that the conclusions presented in this chapter are based on a limited database for which reason the estimation of levels in food might change when more data are provided through the monitoring programmes.

3.1. Quality demands

The requirements to the quality of the sampling and the analytical procedures for dioxins and PCBs are high. The maximum levels in food apply to the upper bound concentrations. Upper bound (UB), medium bound (MB) and lower bound (LB) concentrations are calculated based on the assumption that all the values of the different congeners below the limit of quantification are equal to the limit of quantification, to half of the limit of quantification or to zero, respectively.

It is stated in Commission Regulation 1883/2006, Annex II.6 that:

> "The difference between upper bound level and lower bound level shall not exceed 20% for foodstuffs with a dioxin contamination of about 1 pg WHO-TEQ/g fat (based on the sum of PCDD/PCDF and dioxin-like PCBs). For foodstuffs with a low fat content, the same requirements for contamination levels of about 1 pg WHO-TEQ/g product have to be applied. For lower contamination levels, for example 0.50 pg WHO-TEQ/g product, the difference between upper bound and lower bound level may be in the range of 25% to 40%".

If the levels of dioxins and DL-PCBs are low in a food sample, a small amount of sample and/or low fat content will require low detection limits in order to achieve results that do not have too large difference between lower- and upper bound levels. However, in samples from the Nordic countries with a low contamination level the difference between UB and LB are sometimes more than 40% (Appendix II). National exposure calculations are often based on few samples. However, using data of poorer analytical quality might bee better than using no data, provided that LB, MB and UB exposures are calculated. The possible impact of lipid content in a sample and detection limits is further discussed in Appendix II.

3.2. Occurrence data in Nordic countries compared with maximum levels

Monitoring data from all the Nordic countries that have been reported to the EU are included in this project. Only the sum TEQ of dioxins and DL-PCBs in upper bound concentrations is presented, since the maximum levels in food are defined as the upper bound levels. The majority of the data are on pooled samples, except data from Denmark on meat and dairy products and on some fish samples from Norway and Finland as indicated in the figures.

The purpose of compiling the Nordic monitoring data is to compare the levels found in food in the Nordic countries to the MLs. The data are not complete with respect to national data used for exposure assessments. For practical reasons, and in order to restrict the extent of the project, data from Norway, Sweden and Iceland are from 2002 to 2004, data from Finland are from 1998 to 2004 whereas data from Denmark covers the period from 2000 to 2004. All the countries have newer and older data that are in a similar range.

Data from each country are grouped together in accordance with the maximum level applying for the particular foodstuff (Table 2). Minimum, median and maximum levels (Upper Bound/UB) of sum of dioxins and DL-PCBs are presented as pg TEQ/g fresh weight for fish and other seafood and on a fat basis for other foodstuffs.

3.2.1. Meat and meat products

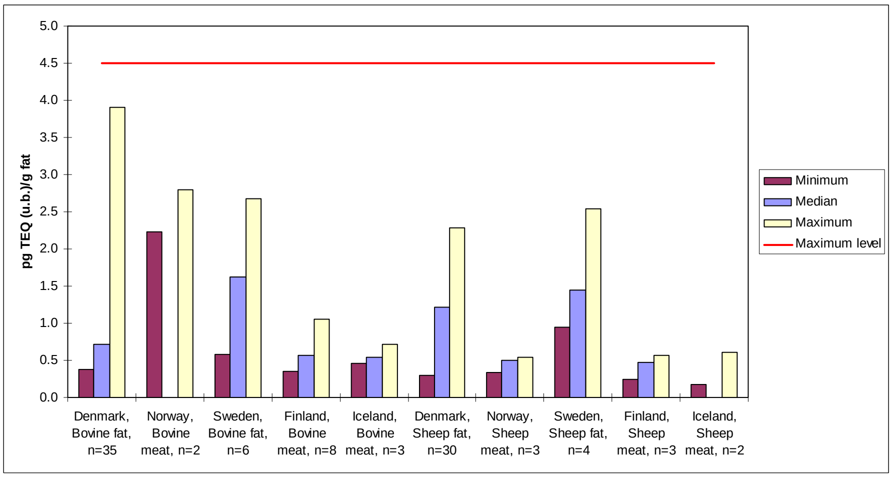

Figure 1 Sum TEQ of dioxins and DL-PCBs in ruminants.

Data in Figure 1 illustrate that none of the Nordic measurements on ruminant meat or fat from ruminants (not milk and milk products) exceeded the maximum level of 4.5 pg TEQ/g fat. The median levels were generally more than 2 pg TEQ/g lower than the maximum level.

Twenty-five percent lowering of the ML to 3.4 pg TEQ/g would only have implications for one sample from Denmark.

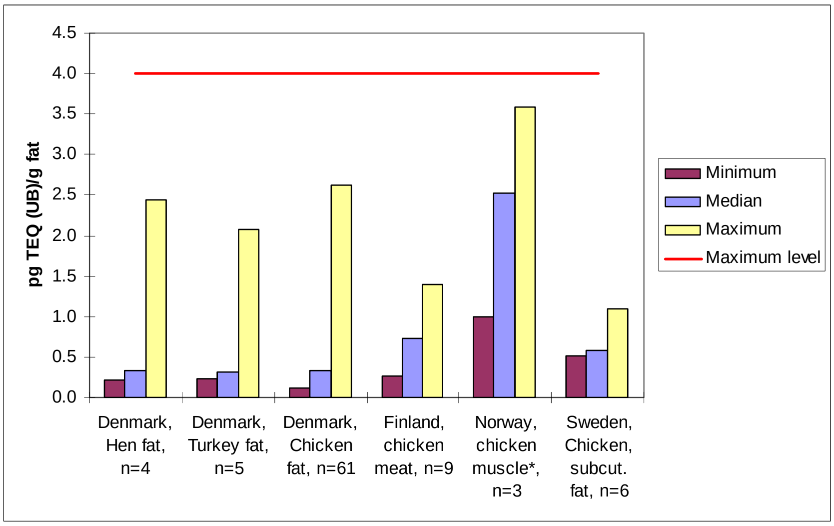

*Figure 2 Sum TEQ of dioxins and DL-PCBs in poultry. * non-ortho PCB is missing.*

Levels in poultry (Figure 2) in Sweden, Denmark and Finland are generally well below the ML. Norway seems to have relatively high levels in chicken meat. Data for the Norwegian chicken does not include non-

ortho PCBs, and it is further noted that there is more than a 10-fold difference between UB and LB levels for non-*ortho* PCBs, implicating that the analytical quality is not sufficiently good. Lowering the ML by 25% to 3 pg TEQ/g would probably have no implication for the supply of chicken

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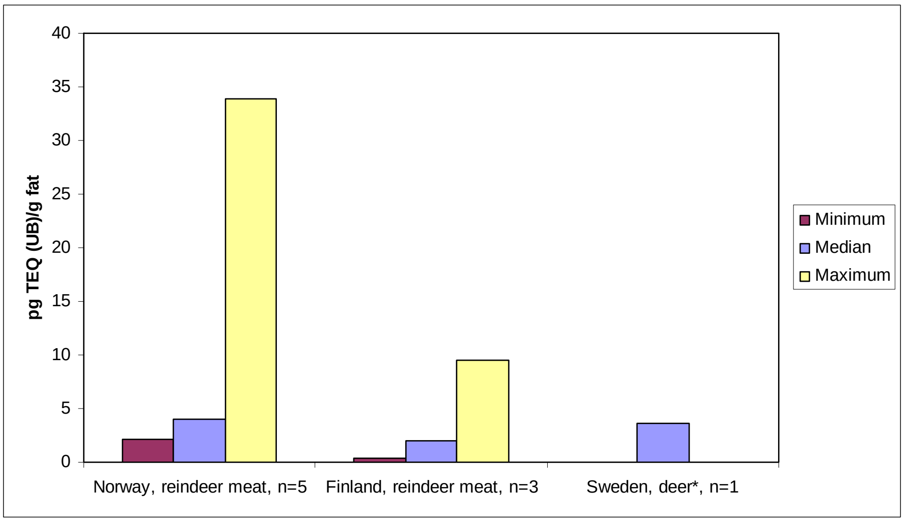

*Figure 3 Sum TEQ of dioxins and DL-PCBs in pooled samples of farmed game. *Medium bound, 1998.*

The levels presented in Figure 3 indicate that reindeer in both Finland and Norway have high TEQ levels. It should be mentioned that although reindeer are regarded as farmed game, they eat grass and lichen in the open country in the northern parts of Norway and Finland, and it is not possible to control the contamination level in feed. There is no ML for farmed game.

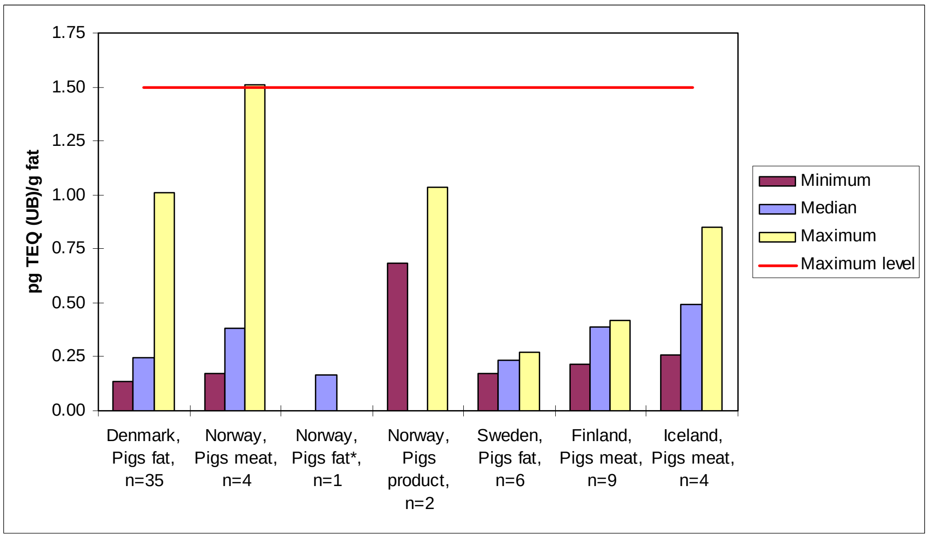

*Figure 4 Sum TEQ of dioxins and DL-PCBs in pork. *non-ortho PCB is missing.*

Figure 4 illustrates the levels found in samples from pork in the Nordic countries. The majority of the samples had levels below 1 pg TEQ/g fat. The reason why one of the Norwegian samples show a contamination level similar to the ML is probably due to the high LOQ determinated when this sample were analysed (for further information see Appendix II). Lowering the ML by 25% from 1.5 pg TEQ/g to 1.1 pg TEQ/g fat would probably have no implications on food supply.

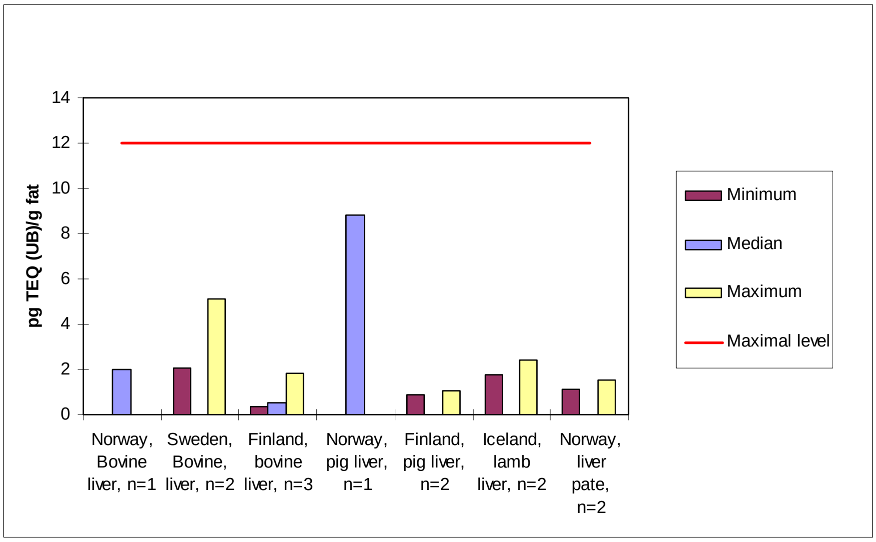

Figure 5 Sum TEQ of dioxins and DL-PCBs in liver and derived products.

Levels in liver shown in Figure 5 indicate that none of the 10 samples that have been analyzed in the Nordic countries exceed the maximum level of 12 pg TEQ/g fat. Lowering the ML by 25% to 9 pg TEQ/g would have no implications for food supply in the Nordic countries.

3.2.2. Muscle meat of fish and fishery products

The TEQ levels in Atlantic fish are generally much lower than the current maximum level of 8 pg TEQ/g fresh weight, as shown in Figure 6. Norway had one sample from large halibut exceeding the maximum level, and this is being handled locally (see section 5.2.2.). Except from Norwegian halibut and one sample of Danish herring, none of the Nordic samples of Atlantic fish exceeded 4 pg TEQ/g, and the majority of samples had levels below 2 pg TEQ/g. Thus, lowering the ML by 25% would have very few implications for food supply.

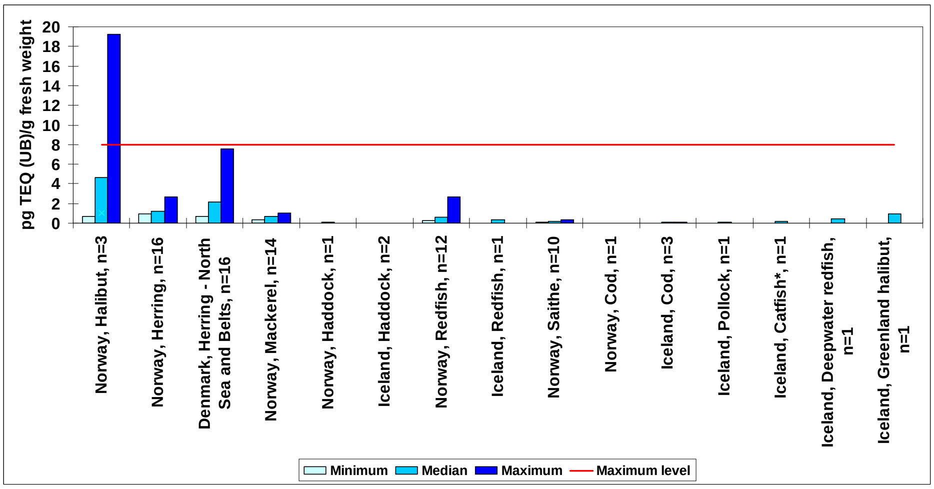

Figure 6 Sum TEQ of dioxins and DL-PCBs in wild marine fish except from the Baltic Sea.

Levels in eel have been reported from Denmark and Norway (Figure 7) and Sweden (Figure 11). One eel sample from the Sound exceeded the maximum level of 12 pg TEQ/g fresh weight, whereas all the samples from the Kattergat west of Hirsholmen generally were below 4 TEQ/g fresh weight. Eel from the Sound is probably affected by pollution from the Baltic Sea or from large cities. In Norway, one eel sample from a region in Hordaland exceeded the maximum level. This was expected, as the region in which the eel was caught is well known to be PCB polluted, and advices not to consume eel or fish liver from the area were given in 1998.

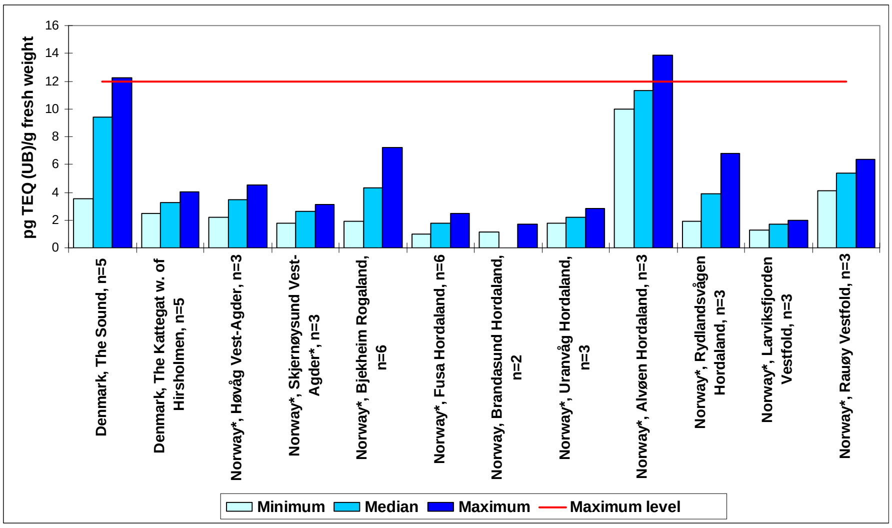

*Figure 7 Sum TEQof dioxins and DL-PCBs in eel outside the Baltic Sea. *average (not median) concentrations are shown.*

Levels in most freshwater fish were considerable lower than the maximum level of 8 pg TEQ/g fresh weight (Figure 8); the median levels in most species were lower than 2 pg TEQ/g fresh weight. Salmon caught in Lake Vänern and Vättern had higher levels, and this has been handled locally. Lowering the ML for fish by 25% or even more would have no implications for the supply of wild freshwater fish.

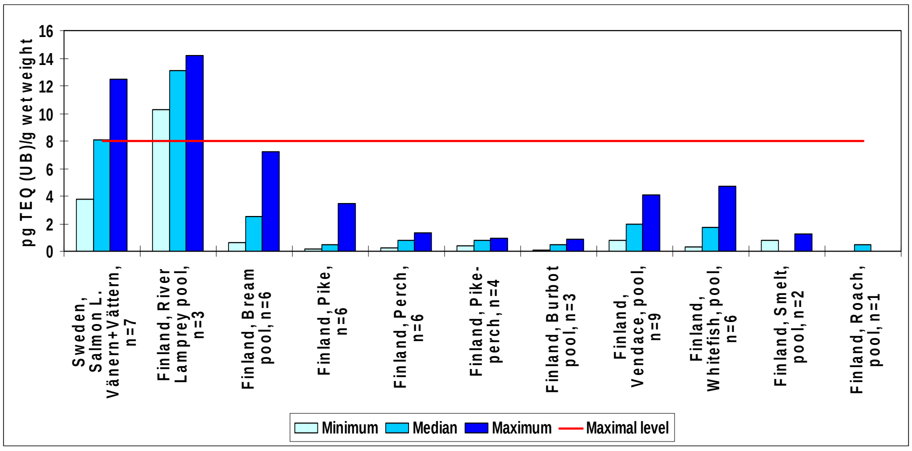

Figure 8 Sum TEQ of dioxins and DL-PCBs in wild freshwater fish. Norway has additional data from trout in Lake Mjøsa at the same level as salmon in L. Vänern.

The maximum level in farmed fish is similar to that in wild fish, 8 pg TEQ/g fresh weight. However, none of the reported levels in farmed fish from the Nordic countries were above 4.0 pg TEQ/g fresh weight, which is half of the maximum level. Lowering of ML for farmed fish by 25% or more would have no implications for food supply (Figure 9).

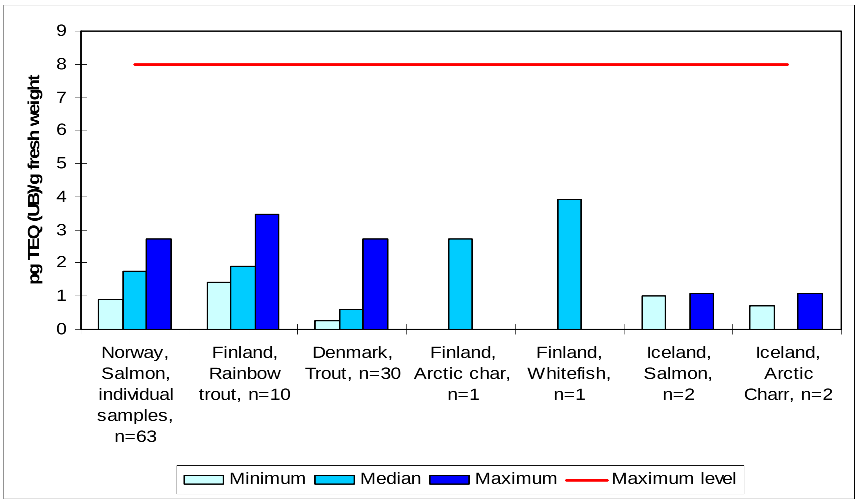

Figure 9 Sum TEQ of dioxins and DL-PCBs in farmed fish.

3.2.3. Baltic region

Because the Baltic Sea is polluted with dioxins and PCBs, TEQ levels in Baltic fish are generally higher than those in Atlantic or freshwater fish. Levels in oily fish often exceed the maximum level of 8 pg (PCDD/DF+DL-PCB) TEQ/g fresh weight. Finland and Sweden have been given a derogation from the regulation, specifying that Baltic salmon, herring, river lamprey, trout, and char, which does not comply with the current MLs, can be sold on the domestic markets only. Measured levels in those species are shown in Figure 10. Measured levels in other Baltic fish are shown in Figure 11.

The way of preparing fish samples for analysis has so far varied between the countries. For example in Finland all fish samples were analysed with skin (“wskin” in figures) but in Sweden, only Baltic herring was analysed with skin. This difference in sample handling can result in large differences in the analytical results. This is depicted in Figure 10 containing Baltic salmon results from Sweden and Finland. The Swedish samples without skin have only half of the TEQ concentrations in Baltic salmon compared to Finnish samples with skin. In the EU regulation 1883/2006 there are more precise instruction on how to handle fish samples in order to get more comparable results between countries. Reducing the ML of fish and products thereof by 25% would mean that also younger and smaller oily fish than currently would exceed the maximum level.

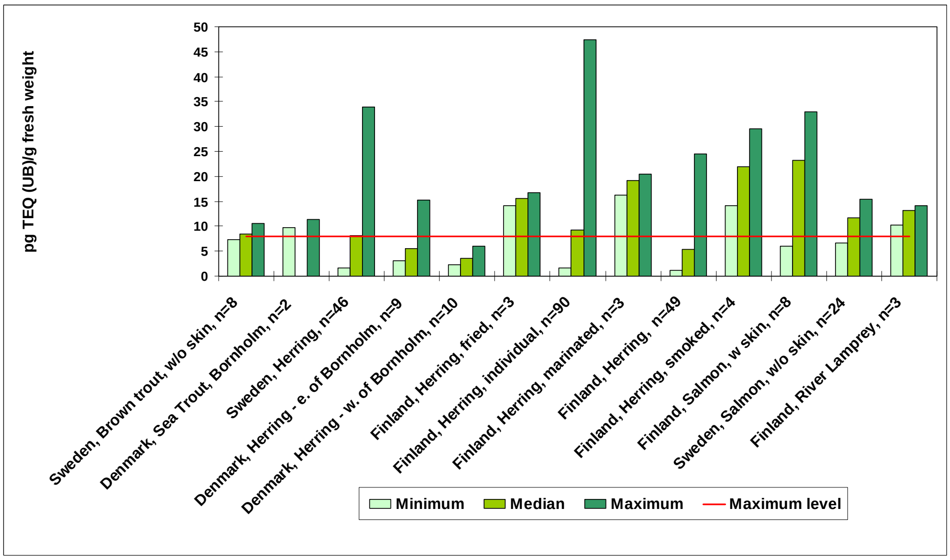

Figure 10 Sum TEQ of dioxins and DL-PCBs in Baltic fish where Sweden and Finland has derogation.

In other fish species without derogation shown in Figure 11, the maximum concentrations measured sometimes exceed the ML of 8 pg TEQ/g fresh weight, most probably due to high age of the fish in the pool (PCDD/Fs and PCBs bioaccumulate with age) or high fat concentration in certain fish species. Reducing the ML by 25% would mean that samples of some fish species, like bream and sprat, very likely would exceed the ML. In non-fatty fish, like pike, pike-perch, roach, and turbot TEQ levels are still below the ML.

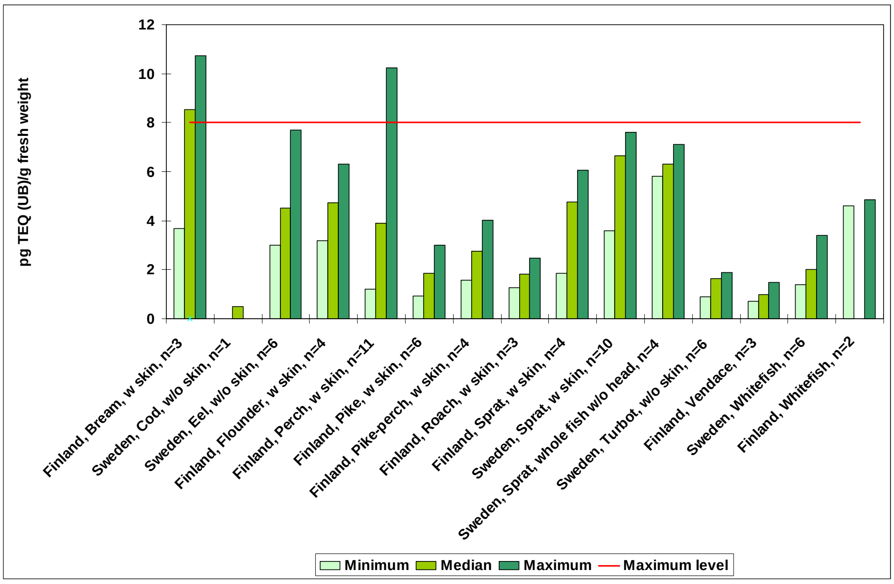

Figure 11 Sum TEQ of dioxins and DL-PCBs in Baltic fish without derogation.

3.2.4. Milk and milk products, including butter fat

The levels in milk and milk products (Figure 12) were all much lower than the maximum level of 6 pg TEQ/g fat. All samples except of one milk product had levels below 2 pg TEQ/g. Lowering the ML by 25% to 4.5 pg TEQ or even more would have no implications for the supply of dairy products in the Nordic countries.

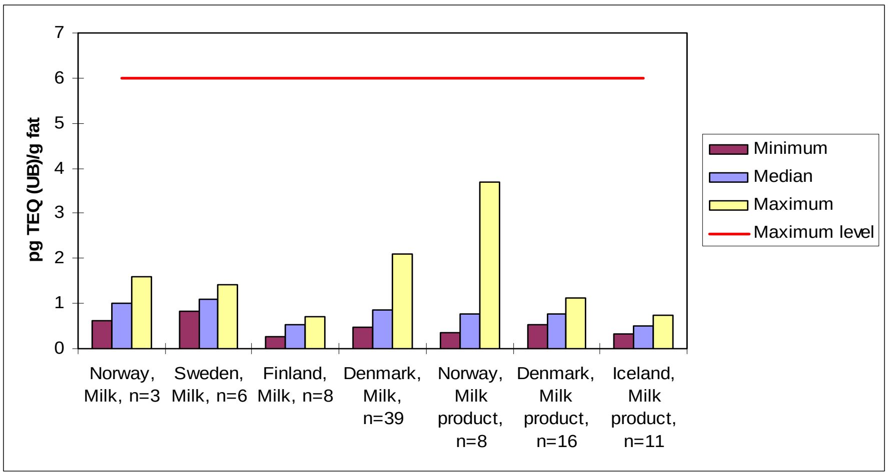

Figure 12 Sum TEQ of dioxins and DL-PCBs in milk and milk products, which include butter.

3.2.5. Hen eggs and egg products

The majority of eggs (Figure 13) had a TEQ level lower than half of the maximum at 6 pg TEQ/g fat. Levels in two samples of free range eggs were higher than the maximum level. However, the majority of eggs had a TEQ level lower than half of the maximum level. Lowering ML by 25% to 4.5 pg TEQ/g fat would implicate that one more of the 12 Swedish samples of free range eggs would have exceeded the lower ML. No other egg sample from the Nordic countries would exceed a ML at 4.5 pg TEQ/g fat.

In eggs from organically farmed hens, the levels of dioxins have in many cases been found to be higher than in conventional eggs. These results have been seen in many countries, and also in the Nordic countries. In Sweden eggs from both conventional and organic farms were sampled and analysed for dioxins and DL-PCBs within the ongoing dioxin monitoring programme. The result showed that most "organic eggs" had higher dioxin levels than conventional eggs. Further investigations carried out 2004 showed that in some egg samples from organic farms, which were using fish meal in the feed, the dioxin levels were even above the current maximum level for dioxins in eggs (3 pg WHO-TEQ/g fat) whereas the levels in conventional eggs, as well as in eggs from organic farms using all-vegetable feed, were low. (However, eggs from organic farm were excluded from the general ML for eggs before 2005.) These findings resulted in that the Swedish feed producers decreased the fish meal concentration in the feed and also changed the fish meal supplier.

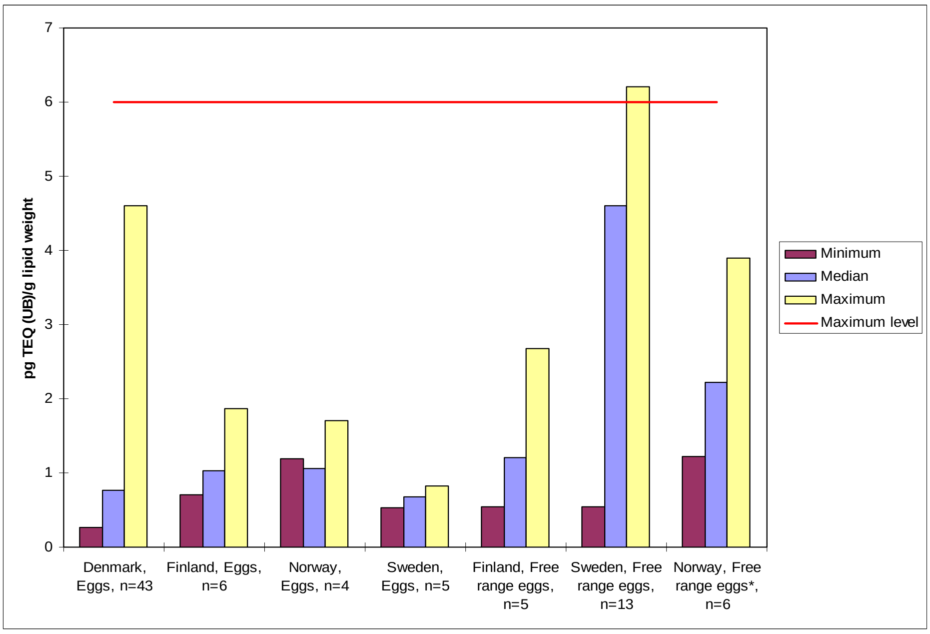

*Figure 13 Sum TEQ of dioxins and DL-PCBs in eggs (conventional) and free range eggs. * Data on mono-ortho PCB is lacking.*

In a project carried out in 2005, eggs, feed and soil from 15 Swedish organic farms were sampled for dioxin analyses. The results showed that the addition of fish meal was the major source of the earlier high dioxin levels found in organic eggs. The levels in the eggs from organic farm using the "new" fish meal containing feed were low, although still somewhat higher than in eggs from conventional farms and from organic farms using all-vegetable feed. The highest measured dioxin level was 1.12 pg WHO-TEQ/g fat, and the highest levels of DL-PCBs were about the same. Results also showed a statistically significant increase in dioxin levels in eggs sampled in August compared to eggs sampled in March.

The small increase could have been caused by the fact that the "outdoor hens" were exposed to dioxins from the soil during spring and summer. Moreover, a correlation between the dioxin levels in soil and eggs could be shown.

To conclude, the egg studies show that the change of feed has resulted in low levels of dioxins and DL-PCBs in organic eggs similar to what is found for conventional eggs, and that the ML for eggs will not be exceeded. Still, the soil quality is of importance for "out-door" hens and should be checked for potential dioxin contamination.

3.2.6. Oils and fats

Figure 14 shows that levels of dioxins and PCBs in vegetable oils and fats are generally low. Since the levels are low, there are a high proportion of non-detected levels of several congeners in all the vegetable oil samples except in the omega 3 margarine. Omega 3 margarine contains oil of marine origin, explaining a higher level than that found in vegetable oils.

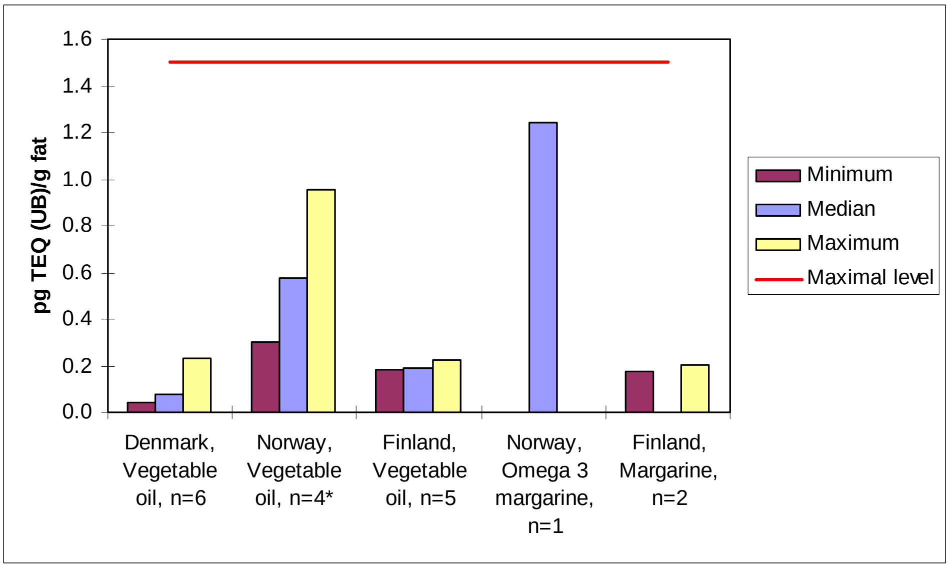

*Figure 14 Sum TEQ of dioxins and DL-PCBs in vegetable oils and fats. *Data on non-ortho PCBs are lacking in two of the samples.*

Lowering the ML by 25% to 1.1 pg TEQ/g fat would have implications only for the omega 3 margarine, in that the manufacturer would have to use better refined marine oil in the production process.

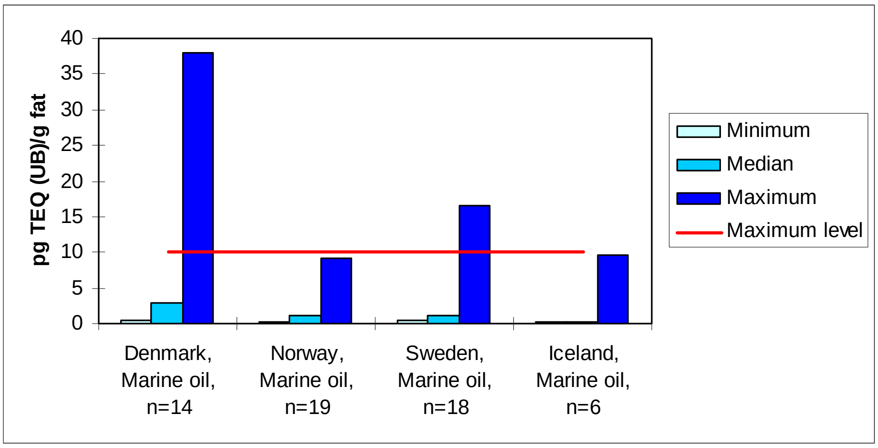

Figure 15 Sum TEQ of dioxins and DL-PCBs in marine oils for human consumption. Samples include cod liver oil, fish oil, shark liver oil and seal oil.

Analyses of more than 80% of the reported marine oil samples from the Nordic countries showed levels below 4 pg TEQ/g (Figure 15), and the median levels were lower than 3 pg TEQ/g in all Nordic countries. Some of the samples exceeded the maximum level at 10 pg TEQ/g. Levels of dioxins and PCB in an unrefined fish oil is dependent on which species the oil originates from, type of tissue (liver or not) and geographical origin of the fish. However, how the oil is refined is also of substantial importance to the final contamination level in oil that is offered for sale. Whereas dioxin content can be greatly reduced by filtering the oil through active coal, levels of DL-PCBs are better reduced by molecular distillation or short-path distillation (Breivik, 2005). TEQ sum and composition of dioxins and DL-PCBs in individual marine oil samples from Sweden (Wallin & Darnerud, 2004) and Norway are depicted in Figure 16. Eight of 45 samples had values above 4 pg TEQ/g. The oils in which the total TEQ content was higher than 4 pg/g fat seem to be only partly refined.

Reducing the ML by 25% to 7.5 pg TEQ/g would exclude 5 of the oils from Iceland, Sweden and Norway. However, none of the refined oils would be excluded, and the ML could be set to 4 pg TEQ/g fat in order to exclude not sufficiently refined marine oils from the market.

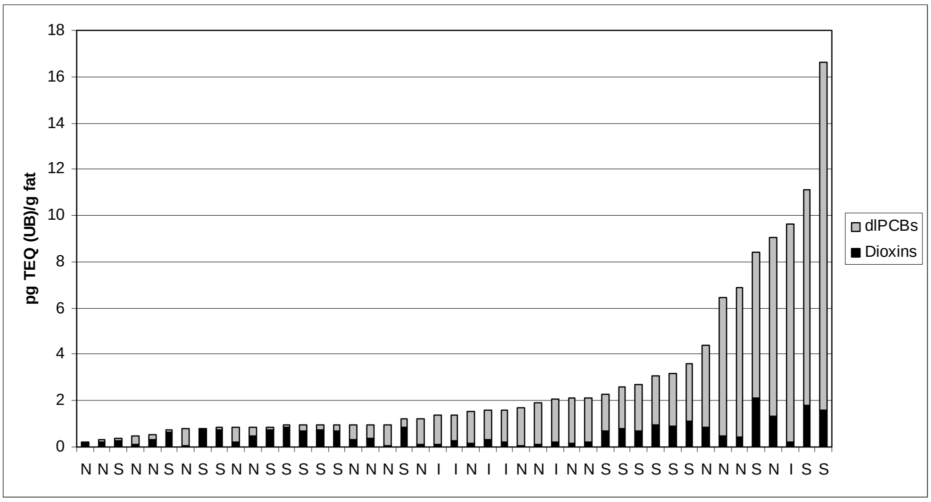

Figure 16 Sum TEQ and composition of dioxins and DL-PCBs in samples of marine oil for human consumption from Norway (N), Sweden (S) and Iceland (I).

4. Exposure

When assessing exposure data from the Nordic countries, the project group has chosen to compare the exposures with EU's TWI of 14 pg TEQ/ kg bw/week. The developing foetus and newborn child, and consequently young females, were identified as the most vulnerable groups in the risk assessment.

4.1. Dietary exposure in the Nordic countries

The dietary exposure to dioxins and DL-PCBs from consumption of a specific food commodity is estimated by multiplying the amount consumed with the concentration of dioxins (expressed as TEQ) in the commodity. The total dietary exposure is the calculated by summing up the contribution from all commodities. In the Nordic countries different methods have been applied in order to estimate the dietary consumption. The studies are summarized in Table 4. More detailed descriptions of the dietary surveys are given in Appendix I.

Table 4 Summary of the dietary surveys used for exposure assessment of dioxins and DL-PCBs in this report

Country	Name of the survey	Method	Year	Number of participants
Denmark	Danskernes kostvaner 2000-2002	7-d food record Pre-code (semi-closed) and amount of food estimated from photos of different portion sizes	2000-2002	3317 (15-75 years) 823 (4-14 years) 232 (4-6 years)
Finland	KTL dietary survey 2002	48-hour recall study	2002	2007
Iceland	The Diet of Icelanders	24 hour recall study	2002	1366
Sweden	Riksmaten	7-d food record and food frequency questionnaire (including fish species)	1997–1998	1212
Sweden	Riksmaten barn	4 days record and food frequency questionnaire (including fish species)	2003	260 ((4 years) 398 (8-9 years) 465 (11-12 years)
Norway	The Norwegian Fish and Game Study	Food Frequency Questionnaire, consumption last year	1999	6015
Norway	Norkost 1997	Quantitative Food Frequency Questionnaire, consumption last year	1997	2672
Norway	Ungkost	Precoded 4-d record, weight of food using photographs of foods items	2000-2001	391 (4 years) 810 (9 years) 1005 (13 years)

The calculated average exposures in each country are all below EU's TWI of 14 pg TEQ/kg body weight/week, as illustrated in Table 5. Iceland has the lowest calculated average exposure at 0.38 pg TEQ/kg bw/day, whereas estimated exposure in Denmark is approximately twice as high. Calculated exposure in Sweden, Finland and Norway are quite similar, at approximately 1.3-1.5 pg TEQ/kg bw/day. There is a 3.8-fold difference between the highest and lowest assessment of average exposures.

Table 5 Average dietary exposure to dioxins and DL-PCBs expressed as pg TEQ/kg bw/day (pg TEQ/kg bw/week) in the Nordic countries.

Food		Denmark*	Finland*	Iceland*	Norway**	Sweden**
Fish	oily		0.29 (2.06)		0.41 (2.86)	0.19 (1.35)
	Baltic oily		0.50 (3.48)			0.38 (2.70)
	other		0.48 (3.35)		0.28 (1.98)	0.11 (0.74)
	Shell-fish				0.11 (0.81)	0.07 (0.47)
	SUM fish	0.31 (2.18)	1.27 (8.91)	0.18 (1.26)	0.8 (5.62)	0.75 (5.26)
Meat		0.15 (1.05)	0.08 (0.58)	0.06 (0.42)	0.22 (1.52)	0.13 (0.93)
Dairy products		0.33 (2.32)	0.06 (0.43)	0.12 (0.84)	0.15 (1.03)	0.19 (1.33)
Vegetable oils			0.01 (0.1)		0.16 (1.11)	0.11 (0.77)
Eggs		0.03 (0.21)	0.03 (0.22)	0.02 (0.14)	0.06 (0.39)	0.01 (0.08)
Other			0.01 (0.1)		0.05 (0.38)	0.11 (0.79)
Sum all		**0.82 (5.76)**	**1,47**	**0.38 (2.67)**	**1.43 (10.04)**	**1.30 (9.15)**

* upper bound concentrations in food, ** medium bound concentrations in food.

The differences in the estimated exposures among adults in the Nordic countries may be caused by differences in food consumption patterns (Table 6), differences in contamination levels in foods, differences in dietary surveys, or most likely a combination of all these. The portion sizes of e.g. fish consumption are also different between the countries (Table 7) which again affects the outcome of exposure calculations.

Table 6 Average food consumption (g/day) in the Nordic countries.

Food		Denmark g/day	Finland g/day	Iceland g/day	Norway g/day	Sweden g/day
Fish	oily		11,5		18	10
	Baltic oily		3,7		-	4,4
	other		19,8		39	21
	Shell-fish		-		10	3,8
	SUM fish	19	35	41,3	70	38
Meat		140	126	71,6	106	103
Dairy products		336	385	423,2	497	390
Vegetable oils			5,7			10
Other fats			-			14
Eggs		16	27	15,1	17	12

Table 7 Differences in portions size used in the intake estimates

Food	Denmark	Finland	Iceland	Norway g/ portion[a]	Sweden g/portion
Cod, haddock	30-126		45-100-175-250	210/170	125
halibut	30-126		45-100-175-250	210/170	
Fish fingers	20**			165/135	125
Fish balls	30-126			165/135	150
Plaice	30-126		45-100-175-250	135/110	125
Herring	30-126	100	60	110/90	125
Salmon/Trout	30-126	100	45-100-175-250	220/170	125
Eel	30-126			75	100
Fish liver				35/30	50
Seafood					90
Shrimps				125/110	
Crab				260	
Mussels				70	

*Male/Female
**20 g for one piece
Denmark and Iceland: Portion size for fish is estimated from photos/figures
Finland: dietary recommendations

Fish is the major contributor to TEQ-exposure in all countries except in Denmark, where dairy products contribute equally (Figure 17). It might be surprising that the calculated average exposure of Norwegians is similar to that in Sweden and Finland, although the fish consumption in Norway is twice of that calculated in Sweden and Finland (Table 6). However, the consumption of oily fish, including Baltic oily fish, is 14-18 grams/day in all countries. Oily fish, and in Finland and Sweden especially oily Baltic fish, is the major contributor to TEQ-exposure from seafood, as illustrated in Figure 18.

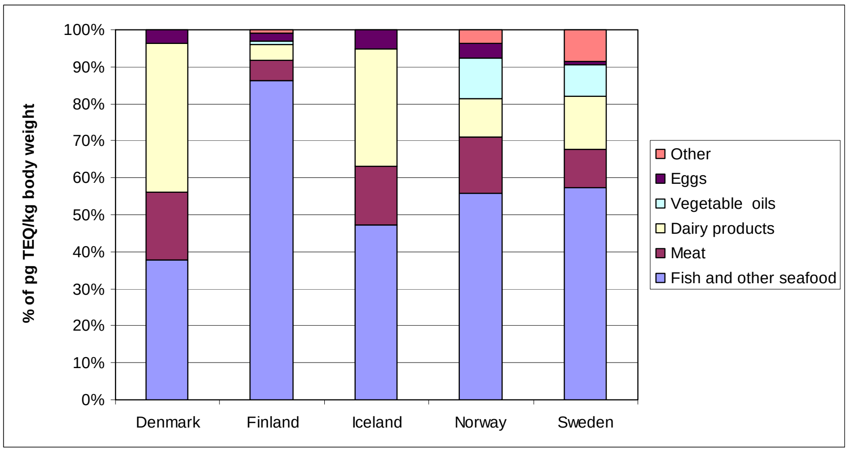

Figure 17 Relative contributions from different food categories to dioxin and DL-PCB exposure in the Nordic countries.

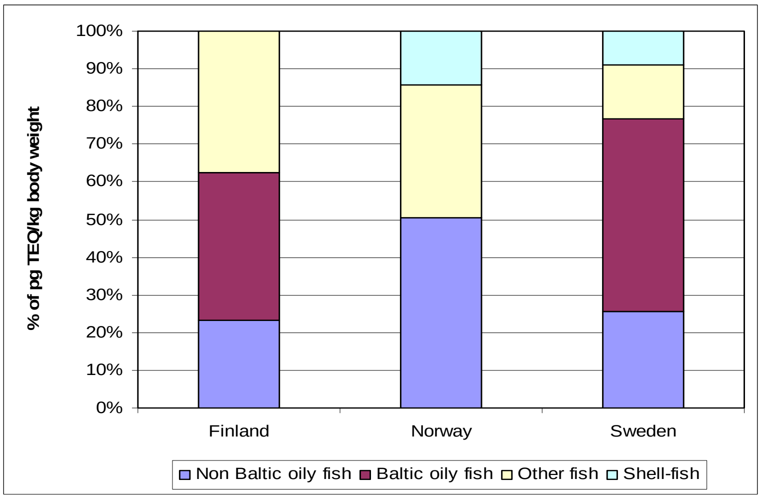

Figure 18 Relative contributions from different seafood categories to TEQ-exposure from consumption of seafood. Finnish calculations: Baltic oily fish includes herring, wild salmon and wild whitefish. Other oily fish includes farmed trout, farmed whitefish, wild whitefish and vendace. Norwegian calculations: Oily fish includes salmon, herring, mackerel, trout, halibut and fish consumed as bread spread. Other fish includes cod liver in addition to non-oily fish and fish products. Swedish calculations: Baltic oily fish includes Baltic herring (also smoked), Baltic salmon and eel. Other oily fish includes herring preserves, west coast herring, other salmoid species (famed salmon, brown trout, artic char and eel), other preserved fish (mackerel, tuna and sardines), caviar and fish liver.

Even though the calculated average TEQ-exposure is below EU's TWI in all the Nordic countries, all countries have population groups that are exposed at a higher level than the TWI (Appendix 1). Calculated exposure distributions are skewed, with a higher mean than median and a long tail towards higher exposure. Only Denmark reported calculated 95th percentile exposure lower than TWI, 12.6 pg TEQ/kg bw. In Norway, calculated weekly 95th percentile exposure from seafood alone was 13.3 pg TEQ/kg bw, whereas calculated weekly 95th percentile exposure from total diet was 19.6 pg TEQ/kg bw in Sweden (Appendix 1).

The calculated exposures presented in Table 5 are for the entire adult population in each country. Exposures are different in different age groups, with the highest levels pr. kg body weight are found among children. Norwegian calculations indicated that the mean intake among 4-year old children is at the same level as TWI, and that the 95th percentile intake among 4-year olds was more than twice the TWI. In Sweden, exposure of children appeared a little higher than in Norway, especially among children 8-12 years old (Appendix 1). In Norway, women in fertile age eat less fish than the population average, and hence, they have lower exposures than the population mean (VKM, 2007). Also in Sweden the TEQ intake among women of 17-40 years of age, i.e. in child-bearing age, is lower than for the average Swedish consumer, and the TEQ exposure from fish is clearly decreased (Ankarberg & Petersson-Grawé, 2005). This seems to be valid for some of the other Nordic countries as well (VKM, 2007)

4.2. TEQ-levels in human milk and serum

Concentration of dioxins and DL-PCBs in human milk has been monitored in Denmark, Finland, Norway and Sweden for several years. Common for these Nordic countries, there has been a substantial decrease in DL-PCBs and dioxins, although the decrease in concentration of dioxins has declined to a lesser extent than the levels of PCBs.

Monitoring results of dioxins and DL-PCBs in mothers' milk from 2000, 2002 and 2004 are summarised in Figure 19. More details about concentrations in mothers' milk from each country are given in Appendix 1. Dioxins contributed in Denmark and Finland with approximately 60% to the results presented in Figure 19 and with a little less than 50% in Norway and Sweden. The mean total TEQ varied from 12 to 17 pg TEQ/g lipid. As the samples were obtain at different years, this could also affect the observed difference in levels between countries. The overall results indicate that the exposure level reflected by concentration in human milk from primiparous women is in the same range in the Nordic countries.

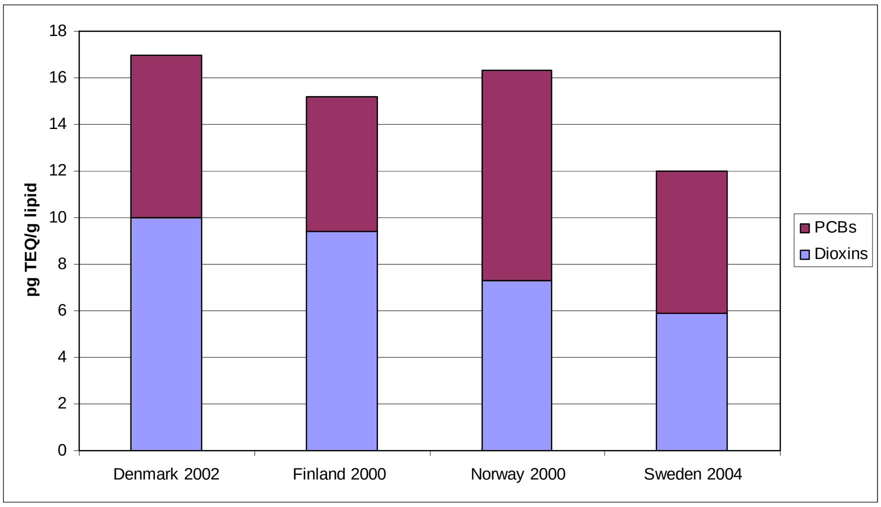

Figure 19 Dioxins and PCBs in human milk. Danish data are from primiparous women age 25–29, average population. Data from Finland are from two pools of breast milk from primiparous women. Norwegian data are average of pooled samples from primiparous women living in three different regions (Tromsø, Hamar and Grenland). Swedish data are from primiparous women living in the Uppsala Region.

4.3. Nordic consumption advice in relation to dioxins and PCBs

Most of the Nordic countries have consumption advices for fish. Several countries have lately carried out a risk-benefit evaluation (Fødevaredirektoratet, 2003; NFA, 2005; VKM, 2007; Becker *et al.*, 2007) to find a good balance between the benefit of eating fish and the need to protect vulnerable groups at risk from exposure of contaminants from some particular fish species. The sub-chapters below give a short summary of the consumption advices given in the Nordic countries related to dioxins and PCBs. Most countries do also have advises related to other contaminants, i.g. methyl mercury, which are not covered by this project.

4.3.1. Denmark

With the current level of dioxin in large salmons from the Baltic region, it is recommend by the Danish food and Veterinary administration, that women in the birth giving age, or pregnant or breast feeding women, do not eat more than one portion of Baltic salmon (app. 125 g) a month. Everyone else can eat Baltic salmon up to twice a month without any health risk.

4.3.2. Finland

Fish eating recommendations have been renewed in Finland in the spring 2004 on the basis of the results from monitoring studies. The purpose of the renewed recommendations is to protect population groups with high intake of fish as well as consumer groups especially sensitive to the contaminants found in fish

Finnish dietary advice on fish consumption

Fish is recommended food and consumption of fish should be increased. Fish contain healthy fatty acids, several vitamins and minerals and a lot of protein. Fish are a particularly good source of n-3 fatty acids and vitamin D. The useful fatty acids contained in fish have been shown to reduce the risk of cardiovascular diseases.

The National Nutrition Council recommends that

- Fish should be eaten at least twice a week
- Different fish species should be varied in the diet.

Exceptions to dietary advice on fish consumption

Despite the favorable nutritional qualities of fish, salmon and herring caught in the Baltic Sea, particularly in the Gulf of Bothnia and the Gulf of Finland, may subject consumers to higher than normal levels of dioxins and PCB compounds which are harmful to health. For these reasons the following special recommendations have been issued to children, young people and people at fertile age.

Large Baltic herring and wild-caught salmon

Large herring, more than 17 cm in length (whole fish), can be eaten once or twice a month and as an alternative to large herring salmon caught in the Baltic Sea can be eaten once or twice a month.

Fish contaminants and dietary advice

The purpose of the dietary advice is to ensure safe consumption of fish. The safety assessments are based on a portion size of 100 g of fish. If the portion eaten is smaller, fish can be eaten more often.

Part (up to one third) of the dioxins and PCB compounds accumulated in fish can be removed by skinning the fish before preparing it as food. The exceptions to dietary advice do not apply to small herring, less than 17 cm long (whole fish). Filleted herring are usually large, more than 17 cm in length.

Farmed fish contain only low levels of dioxins and PCB compounds, thanks to the control of fish feed quality.

The research reports and the new dietary advice and info package on fish can be found on the web site of the National Food Safety Authority (www.evira.fi) (publications).

4.3.3. Iceland

Iceland has consumption advice for expectant mothers (both for persistent organics and mercury):

- Avoid consumption of: Shark, whale blubber, cod liver, big halibut (>1,8m or 60 kg), fulmar and fulmar eggs.
- No more than twice/week: minke whale, other seabird eggs, tuna fish.

4.3.4. Norway

Norwegian food authorities have a long tradition for giving consumption advice for contaminants. The consumption advices for dioxins and DL-PCBs are specifically directed at women of childbearing age and children, but they also include other parts of the population. The current advice for children, pregnant women and women in fertile age are that they should not eat fish liver or sandwich spread made of fish liver. Other groups of the population should only have a limited consumption of fish liver and sandwich spread made of fish liver. Advice is also given to women of childbearing age that they should not eat brown meat from crab. Gull’s eggs are considered a delicacy, especially in the northern part of Norway. They do however contain high levels of dioxins and PCBs, and consumption advice is given both to consumers in general (to limit the intake of these eggs), and to young women (not to eat at all).

The Norwegian Food Safety Authority has issued consumption advice for 32 polluted harbours and fjord areas in Norway. These advices are directed both at consumers in general and to vulnerable groups. It should be noted that most of the fish liver data are from some of these 32 areas, which have both consumption advice (for sports fishers) and prohibition against commercial fishing. Fish products from these areas are therefore not allowed to be placed on the market.

4.3.5. Sweden

Dietary recommendations aiming at restricting the consumption of certain fish species due to increased levels of environmental pollutants were introduced in 1968, at first mainly concerning fish with high methyl mercury levels. Later dietary restrictions have been introduced due to contamination caused by organic pollutants as dioxins and PCBs. The dietary advice on Baltic oily fish was revised in 1995, when women in childbearing age were identified as a group of special concern and in need of more restrictive recommendations.

The Swedish dietary recommendations on fatty fish from the Baltic region are the following:

Girls and women in childbearing age are recommended not to eat more than a total of one meal per month of Baltic herring, wild-caught salmon and trout from the Baltic Sea, and of salmon and trout from Lake Vänern and Vättern, and of arctic char from Lake Vättern. Consumption of liver from cod and burbot should be avoided. For other consumer groups the advice is a maximum of one meal per week of the specified fishes, and not more than occasional servings of cod and burbot liver. For all consumer groups, farmed fish could be consumed without restrictions.

The above recommendations are for the moment under revision, and pupated Swedish recommendations will be presented during 2008.

5. Impact on exposure with lower maximum levels

5.1. Meat and meat products, milk and milk products, hen eggs and egg products

Calculations in all the Nordic countries indicate that meat contribute with less than 20% of the dietary exposure (Figure 17). Lowering the MLs for meat with 25% would generally not affect exposure since contamination levels in meat are generally very low. However, dioxin and PCB level in farmed game is an exception. But since the fat content in reindeer meat is low, and the consumption rates are low, reindeer meat contributes very little to the dietary exposure to dioxins and PCBs in the general population. Little is known about the consumption patterns among Sami populations, and Samish living in a traditional way may be a group at risk of high exposure to dioxins and DL-PCBs. Since contamination levels in reindeer feed can not be controlled, this could be handled by giving dietary advice to these groups of the populations.

Milk and milk products contribute with approximately 35% of dioxin and DL-PCB to the Danish dietary exposure, whereas this food group contributed with less than 15% in the other Nordic countries (Figure 17). Lowering of the ML with 25% would have no impact on exposure, since levels of dioxins and DL-PCBs in milk were much lower.

Some of the analysed samples from free range eggs had contamination levels that would exceed an ML at a level 25% lower than the current ML. However, eggs contribute little to the total exposure of the Nordic consumers. Consequently, a 25% reduction of ML for eggs will only marginally affect food supply as well as exposure.

5.2. Muscle meat of fish and fishery products

Fish is a major source of dioxins and DL-PCBs (Figure 17) and it contributes at average more than 85% in Finland, approximately 50% in Iceland, Norway and Sweden, and more than 35% in Denmark. Oily fish contributes with 50-75% of the dioxins and DL-PCB exposure from fish in Denmark, Norway and Sweden.

5.2.1. Salmon

Exposure to persistent organic pollutants by consumption of farmed fish has attracted considerable attention in recent years. The range of TEQ-sum of dioxins and DL-PCBs in farmed fish in the Nordic countries was 0.26 pg TEQ/g to 3.9 pg TEQ/g, as illustrated in Figure 9 in this report. The median level in salmon and trout was below 2 pg TEQ/g fresh weight. Thus, both the median and maximum levels found in farmed fish were considerably lower than the ML of 8 pg TEQ/g.

The TWI of 14 pg TEQ/kg bw corresponds to 980 pg TEQ for a person weighing 70 kg. If farmed fish contained 8 pg TEQ/g, this person could eat approximately 125 g farmed fish weekly before exceeding the TWI by the contribution from farmed fish alone. The actual exposure would be higher, since contribution from the rest of the diet would be in addition.

Contamination levels in farmed fish can be altered by changing the levels in fish feed. The impact on exposure with different TEQ-levels in farmed fish has been calculated for the Danish and Norwegian diet.

5.2.1.1. Impact of altered TEQ-level in salmon on dietary exposure in Denmark

As an example the impact of eating salmon with different TEQ-levels has been estimated on the exposure of Danish consumers (Appendix 1). In average 13% of the Danish fish consumption is from salmon. The impact of different TEQ-levels on the contribution from consumption of these 13% was assessed. The calculations based on the total Danish diet indicate that an increase of the TEQ-level in salmon from 3 pg/g to 6 pg/g or to 12 pg/g would cause an increase of the total exposure from 41% of the TWI to 46% and 55% of the TWI, respectively. Similarly, the 95th percentile exposure level would increase from 90% of TWI to 120% and 185% of TWI, respectively (Table 8).

Table 8 Effect of various TEQ-level in the salmon part of the fish intake on total dietary exposure in Denmark

	Total exposure pg TEQ/kg bw/day (% of TWI)		
	mean	median	95th percentile
3 pg TEQ/g salmon	0.82 (41%)	0.67 (33%)	1.8 (90%)
6 pg TEQ/g salmon	0.92 (46%)	0.68 (34%)	2.4 (120%)
12 pg TEQ/g salmon	1.1 (55 %)	0.7 (35%)	3.7 (185 %)

5.2.1.2. Impact of altered TEQ-level in farmed fish on dietary exposure in Norway

The TEQ-levels in farmed fish affects the total exposure from fish and other seafood because the majority of Norwegians eat farmed fish. This is illustrated in Figure 20, which presents the significance of different TEQ-levels in farmed fish on the total TEQ-intake from fish and other seafood.

The estimates are based on fish consumption data from the Norwegian Fish and Game Study, Part A, and exposure from the rest of the diet will come in addition. Due to the fact that many people are unaware of whether the fish they eat is wild or farmed, different levels of dioxins and DL-PCBs (0.5 pg TEQ/g fish, 1 pg TEQ/g fish, 1.5 pg TEQ/g fish, 2 pg TEQ/g fish and 2.5 pg TEQ/g fish) have been used for all salmon and sea trout, and not simply for farmed fish. These estimates show that a reduction in levels of dioxins and DL-PCBs from 2 pg TEQ/g fish to 0.5 pg TEQ/g fish lowers the average exposure from all fish and other seafood by roughly 25%. A high consumption (95th percentile) of salmon and sea trout amounts to about one weekly meal of 200g fish.

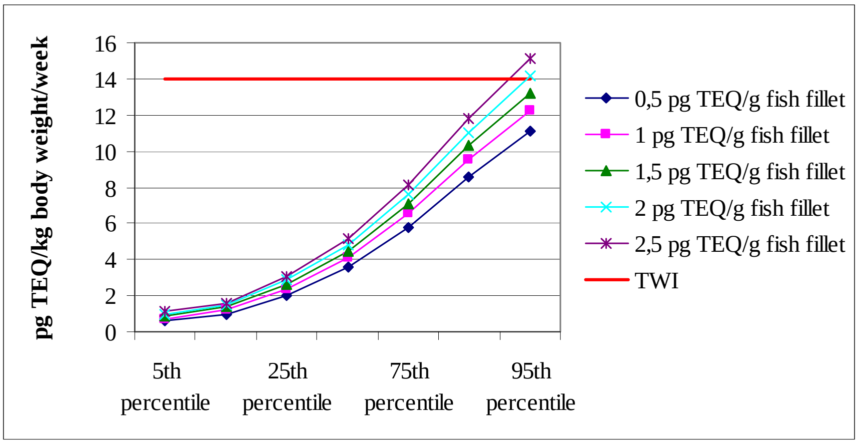

Figure 20 The significance of varying contamination levels in salmon and trout for TEQ exposure from dioxins and DL-PCBs in fish and other seafood. The estimates include all participants in the Fish and Game Study, Part A. The exposure from other food plus any cod liver oil consumption will be in addition to this. The horizontal unbroken red line shows TWI for dioxins and DL-PCBs (14 pg TEQ/kg bodyweight/week). On average, total consumption of salmon and trout is 8.7 g/day, and average among consumers only 9.5 g/day. This corresponds to 1.4 meals of 200 g fish per month. A high consumption (95th percentile) of salmon and sea-trout corresponds to about four meals per month, according to the Fish and Game Study, Part A. (VKM, 2007).

Sales figures reveal that the purchase of farmed fish by Norwegian households is increasing (Directorate for Health and Social Affairs, 2004). The Norwegian dietary surveys were conducted in 1997 and 1999, and the consumption of farmed fish may therefore be underestimated. To account for this, theoretical estimates have been made of the exposure to dioxins and DL-PCBs in adults based on a varying number of portions of farmed fish when the farmed fish have different degrees of contamination, illustrated in Figure 21. These estimates have been made for farmed fish using the 2004 average level in Norwegian salmon (1.7 pg TEQ/g) and for salmon using higher (2.5 pg TEQ/g) and lower (1.0 pg TEQ/g) values.

The estimates show that with a consumption of between 1.5 and 2 weekly meals (150-200g) of farmed fish with 1.7 pg TEQ/g, the combined total exposure for dioxins and DL-PCBs from all foods will reach the TWI level. If the average level in salmon were 1 pg TEQ/g, it would be possible to eat three weekly meals (600g) of salmon before the total exposure from all food would reach TWI. If the average level were 2.5 pg TEQ/g, only one weekly meal (200g) of salmon could be eaten before the total exposure from all foods reached TWI.

This must be regarded as a highly simplified approach. The consumption of a number of other foods will also play an important role, e.g. the consumption of seagull's eggs and/or brown crabmeat will also greatly increase the exposure. The exposure from other seafood is not included in the estimates, but with a high consumption of oily fish it may be assumed that other seafood would be a small contributor. Based on the Norwegian dietary studies, few people eat more oily fish (including cold cuts and bread spreads made of fish) than the equivalent of two meals per week (400 g per week or 57 g/day).

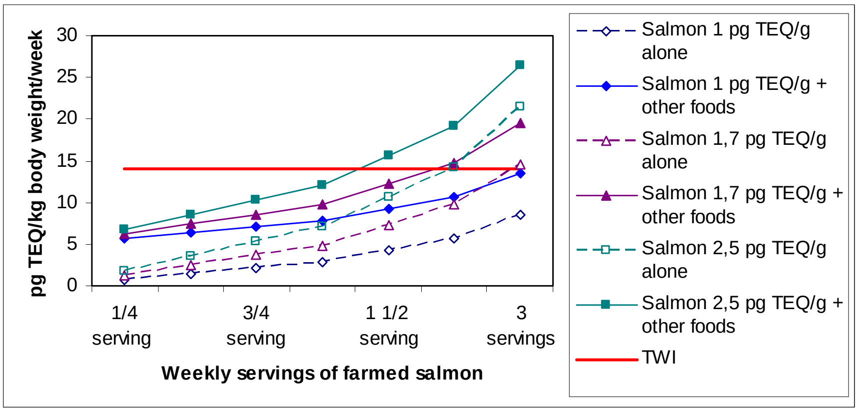

Figure 21 Simple model estimates of weekly intake of dioxins and DL-PCBs for different patterns of consumption of farmed salmon with varying contamination levels. A meal is equivalent to 200g salmon. The stapled lines represent exposure from salmon with different contamination level alone. The solid lines are estimates of exposures from total diet and come from addition of other foods than salmon to the exposure from salmon. Other food (4.95 pg TEQ/kg body weight/week) represent the median intake from food other than fish and other seafood given in NORKOST 1997 (4 pg TEQ/kg body weight/week) with the addition of a recommended daily intake of cod liver oil (0.95 pg TEQ/kg body weight/week). The horizontal unbroken red line represents TWI for dioxins and DL-PCBs (14 pg TE/kg bodyweight/week) (VKM, 2007).

5.2.1.3. Conclusion - impact of altered TEQ-level in salmon

The Norwegian estimates indicate that with consumption corresponding to about two weekly meals of farmed fish with an average of 1.7 pg TEQ/g, the total exposure to dioxins and DL-PCBs from the entire diet is equal with the TWI. The exposure from the entire diet may be reduced by an average of 25% if the levels of farmed salmon are reduced from 2 to 0.5 pg TEQ/g fish (VKM, 2007).

Changing TEQ-level in farmed salmon in Denmark seems to have lower impact on total exposure than it has among Norwegian consumers. This is probably due to different consumption patterns in the two countries and lower fish consumption in Denmark. In Denmark only 13% of the average fish consumption is salmon. In Norway this proportion is probably higher, and 30% of the fish consumption is oily fish. Further, it should be kept in mind that the calculated Norwegian dietary exposure is approximately 1.7-fold higher than that in Denmark, and that a lower proportion of the Danish population is at risk of exceeding the TWI for dioxins and DL-PCBs.

5.2.2. Halibut

Opposing to farmed fish, nothing can be done to reduce the occurrence level in wild fish species on a short time perspective.

Figure 6 shows that all Atlantic fish samples except the oily species (halibut, herring, mackerel and redfish) reported from the Nordic countries contained less than 1 pg TEQ/g fresh weight. Thus, lowering the maximum level in lean species to 1 pg TEQ has no effect either on food supply or on exposure.

Impact of halibut consumption on exposure in Norway

As shown in Figure 6, one of the Norwegian halibut samples showed levels far above the maximum limit. Based on the levels of organic contaminants in the three halibut samples in Figure 6 an additional survey on organic contaminants in halibut was initiated (Table 9).

Table 9 Concentration of dioxins and DL-PCBs (pg TEQ/g fresh weight) in halibut with different size (VKM, 2007).

Halibut	Weight (kg)	Dioxins and furans (pg TEQ/g)	Dioxin-like PCBs (pg TEQ/g)	Total, dioxins and PCBs pg TE/g
1	1.1	0.04	0.16	0.19
2	1.5	0.06	0.14	0.20
3	2.8	0.04	0.10	0.14
4	30	0.34	1.84	2.2
5	31	0.79	3.74	4.5
6	34	0.33	1.44	1.8
7	121	3.38	26.36	29.7
8	129	4.30	16.77	21.1
9	151	4.35	20.12	24.5

The results in Table 9 indicate that the levels of dioxins and PCBs are dependent on the size of the halibut. Whereas the levels were low in the small halibuts with weight between 1 and 3 kg, the levels in halibuts weighing more than 120 kg was very high. In the halibut of size 30-35 kg the dioxin and PCB levels were comparable with those of other oily wild saltwater fish and farmed fish (Figure 6 and Figure 9). There were no data on levels in halibut between 30 and 120 kg.

Total exposure from consumption of fish and other seafood has been estimated with different contamination levels in Halibut based on consumption data from The Norwegian Fish- and Game Study, Part A (Meltzer *et al.*, 2002), Table 10 (VKM, 2007). Levels in other seafood than halibut were kept constant. Calculations have been performed on all participants in the study. Level 2 correspond to the average level reported to the EU in 2003 (shown Figure 6). Level 1 corresponds to that found in halibut smaller than 35 kg, whereas levels 3 and 4 correspond to levels in halibut larger than 100 kg.

Table 10 Estimated weekly TEQ exposure to dioxins and DL-PCBs from fish and other seafood, provided different contamination levels in halibut. Food consumption data are from The Norwegian Fish- and Game Study part A, all participants.

	Level 1 **4 pg TEQ/g in halibut**	**Level 2** **8.2 pg TEQ/g in halibut**	**Level 3** **20 pg TEQ/g in halibut**	**Level 4** **30 pg TEQ/g in halibut**
Median intake pg TEQ/kg bw/week	5.9	6.6	8.9	11.1
95th percentile pg TEQ/kg bw/week	16.7	19.1	28.6	37.8

Table 10 shows that both median and 95th percentile exposure to dioxins and DL-PCBs from fish and other seafood was highly dependent on the contamination level in halibut. Doubling the total TEQ level in halibut from 4 pg TEQ/g to 8.2 pg TEQ/g led to a 12% increase in median dioxin and PCB exposure from fish and other seafood. An increase of TEQ level in halibut from 4 to 30 pg TEQ/g doubled the TEQ intake from fish and other seafood.

More than half (n=3297, 55%) of the participants in the food consumption survey were consumers of halibut. Among them, average consumption of halibut was 4 g/day, corresponding to approximately 7 meals per year. High consumption (95th percentile) was 11 g/d for females and 14 g/day for males, corresponding to approximately two meals per month.

Median and 95th percentile exposure from halibut alone was 1.2 and 4.9 pg TEQ kg bw/week respectively, assuming that the level in halibut was 4 pg TEQ/g; similar to the highest level in fish that was smaller than 35 kg. If the contamination level was similar to the maximum limit of 8 pg TEQ/g, consumers of halibut would fill up 70% of the TWI by eating halibut twice a month.

As a consequence, the large fish producer in Norway volunteered not to trade halibut larger than 35 kg. Additionally, the Norwegian Food Safety Authority has initiated further research on dioxins and DL-PCBs in different halibut as well as stated that large halibut should not be eaten.

5.2.3. Eel

The ML in eel at 12 pg TEQ/g is very high. Two monthly eel meals (2*75g) would contribute with 50% if the TWI for a person weighing 70 kg, and exposure from other food would come in addition. Allowing this high level in eel implies that a guidance/information on eel consumption must be given to young women that may become pregnant.

5.2.4. Baltic region

In Finland and Sweden the Baltic fish is a major source, and since it takes very long time to reduce levels in the Baltic Sea, contribution from this source can only be reduced by dietary advices or exclusion from the market.

5.2.5. Oils and fats

Fish oil supplements are widely used in Norway and Iceland due to national recommendations. The Norwegian Directorate for Health and Social Affairs recommends a daily use of fish oil supplements to the whole population, including infants and small children in order to secure a sufficient intake of vitamin D and omega-3 fatty acids. It is very likely to believe that marine oil supplements are widely used also in the other Nordic countries, at least among sub groups in the population.

Raw cod liver oil, i.e. unrefined oil from the liver of cod and haddock, contains substantial amounts of PCBs and dioxins. In Norway the use of refining techniques ensures that the commercially cod liver oil has a considerably lower level of these contaminants. Analyses conducted by the Norwegian Food Safety Authority in 2004 and 2005 show a variation in the total of dioxins and DL-PCBs from 1.0 – 2.9 pg TEQ/g cod liver oil. An average content of 2.0 pg TEQ/g refined cod liver oil is used in the exposure estimates. In fish oil capsules, measurements showed on average 0.74 pg TEQ/g oil. Cod liver oil is produced from the liver of cod and haddock while the capsules may contain fish oil from other sources. Table 11 shows the exposure to dioxins and DL-PCBs from cod liver oil and fish oil if the recommended dose is followed. In addition, the table shows theoretical exposure for dioxins and DL-PCBs from cod liver oil with content of 5 (national ML in Norway) and 10 (ML in EU) pg TEQ/g.

Table 11 Theoretical exposure among adults and children (different age groups) to dioxins and DL-PCBs (pg TEQ/kg bodyweight/week) from cod liver oil and fish oil. Different levels of sum dioxins and DL-PCB (pgTEQ/g) are used in the calculations. The amount of cod liver oil is set in accordance with the Norwegian recommendations.

	Adults 18-79 Year 74 kg pg TEQ/kg bw/week	Children 13-years 49 kg pg TEQ/kg bw/week	Children 9-years 32 kg pg TEQ/kg bw/week	Children 4-years 18 kg pg TEQ/kg bw/week	Children 2-years 13 kg pg TEQ/kg bw/week	Children 1-year 10 kg pg TEQ/kg bw/week	Children 4 weeks 5 kg pg TEQ/kg bw/week
Fish oil capsule* (0.74 pg TEQ/g)	0.07	0.11	0.16	0.29	0.40	-	-
Cod liver oil** (2 pg TEQ/g)	0.95	1.4	2.2	3.9	5.4	7.0	7.0
Cod liver oil** (5 pg TEQ/g)	2.4	3.6	5.5	9.7	14	18	18
Cod liver oil** (10 pg TEQ/g)	4.7	7.1	11	19	27	35	35

*Amount of fish oil used in the calculations; oil in a capsule is set at the amount recommended for one type of product (2 capsules, 1.2 g oil/day). For other products, the recommended daily dosage may differ.

**Amount of cod liver used in the calculations is set in accordance with the Norwegian recommendations; 5 ml, approximately 5 g/day from 6 months and 2.5 ml from 4 weeks to 6 months.

Table 11 illustrates that the intake of dioxins and DL-PCBs from purified cod liver oil alone may constitute up to 50% of the TWI for dioxins and DL-PCBs (14 pg TEQ/kg bw/week). The intake in relation to the body weight is highest among the youngest children because the recommended amount of cod liver oil in Norway is the same for adults and children, with the exception of children age 4 weeks to 6 months for whom the recommended dosage is 2.5 ml/day. Table 11 also illustrate that a content of both 5 and 10 pg TEQ/g fish oil will increase the intake of dioxins and DL-PCBs substantially, especially among small children.

6. Discussions and recommendations

This chapter reflects the discussions the Nordic group had during their meetings in this Nordic project "Review of maximum levels for dioxins and dioxin-like PCBs, impact on the consumer exposure and the food supply". The conclusions and recommendations are not necessarily the official view in the Nordic countries. However, the conclusions reflect the discussion in the group, and the work on dioxins and DL-PCBs carried out in the Nordic countries.

The Nordic group has discussed the impact on food supply in the Nordic countries, based on occurrence data presented, and if current MLs for dioxins and DL-PCBs are reduced with 25%. This reduction has been chosen since this figure has been suggested in earlier EU documents. In the Commission Regulation (EC No 1881/2006) a fixed figure of a reduction of the MLs is not presented, but the object is still to reduce the MLs for dioxins and DL-PCBs by the end of 2008. The work with this Nordic task has shown that lowering MLs with 25% for dioxins and DL-PCBs for all food categories in the EU legislation would just have minor, if any, impact on food supply (see chapter 3).

To look at MLs impact on exposure to dioxins and DL-PCBs, the same figure for reduced MLs (25%) has been used. In addition some other realistic levels have been used in theoretical intake estimates for some food categories to show impact on exposure. It should be kept in mind that the conclusions presented are based on few data and knowledge to levels in foods could change when more data is provided through the monitoring programmes. A reduction of existing MLs by 25% or even more will not have any effects on exposure in the Nordic population and the Nordic group does not believe that MLs is the best tool to reduce exposure in the Nordic countries (see chapter 5). When MLs in EU are being set, all Member States have to be heard, and different countries in EU have different contaminant levels found in their food. The most contaminated food group in one country might be different in other countries. The result in the EU negotiation is that MLs are set at a level, which excludes only the most contaminated food from the market. The Nordic group therefore believes that substantially lower action levels than the existing action levels could be a better tool to reduce exposure in the Nordic population.

As an overall conclusion the Nordic group is in favour of considering as low as reasonable achievable (ALARA) principles when setting MLs, since the exposures in the Nordic countries are close to TWI. The application of ALARA is stated in EU regulations dealing with contaminants, and this principle is also one of the most important tools to avoid contaminated food to enter the EU market. Since the MLs in most cases are above the actual levels found in food in the Nordic countries, it can be deduced that EU's MLs are not in accordance with the ALARA principles for most foodstuffs from the Nordic countries.

It is also difficult to communicate that consumption advices are necessary on certain food product, even though the levels of dioxins and DL-PCBs are below the MLs. Another concern in the Nordic countries, when MLs are set much higher than necessary, is that food from abroad with an elevated level of dioxins and DL-PCB could enter the Nordic marked legally, and then lead to a higher exposure in the population (e.g marine oils).

In farmed fish the levels found reflect the levels in the feed and in domestic animals the levels found reflect the levels in the feed and to a less extent in the environment. As a consequence, the most efficient way of lowering levels in those food groups is to regulate the levels in feed.

Another conclusion from the Nordic group is that it is still necessary to reduce the exposure levels for dioxins and DL-PCBs in the Nordic countries, at least among some subgroups in the population. All the Nordic countries have consumption advices as a risk management tool to reduce exposure of dioxins and DL-PCBs in their population. It could always be questioned how effective such advices are. If MLs in EU are kept too high, there might be a need to extend the consumption advises in the Nordic countries, which again will complicate risk communication.

6.1. Meat and meat products, milk and milk products, hen eggs and egg products

As shown in this report lowering MLs for meat and meat products, milk and milk products by 25% will not affect neither exposure nor food supply in the Nordic countries. The project group would prefer to lower the MLs for these food groups.

A few samples from free range eggs exceeded the ML. In a Swedish survey (section 3.2.5.) it was found that feed containing marine oil had been used in the feed for free range hens. After changing the feed, the contamination level in eggs were similar to conventional eggs. Still, the soil quality is of importance for out-door hens, and should be checked for potential dioxin or PCB contamination.

High levels have been found in reindeer meat from some areas in northern parts of Norway and Finland. The elevated levels found might contribute significantly to the overall exposure for dioxins and DL-PCBs for population groups, like Sami populations, were reindeer is an important food in the diet. Since contamination levels in reindeer feed can not be controlled, this could be handled by giving dietary advice to these groups in the populations. More data on consumption habits and levels found in reindeer meat is needed. Cooperation between the Nordic countries is probably necessary to address this issue.

6.2. Fish and fishery products

Setting MLs for contaminants in fish as one food group has often caused a challenge for the competent authorities (e.g. EU legislation for methyl mercury, cadmium and lead). Fish as one group consist of many different fish species with different food habits, habitats, life span etc. Consequently they accumulate environmental contaminants differently and the level of a contaminant found in different fish species could vary by a factor 10 or more. Further, huge differences of levels of a contaminant have been reported in individuals of the same fish species from different regions, levels found in wild fish normally reflect the contaminant status of the environment where they live.

Farmed fish are also included in the fish group even though they are receiving the contaminants from feed, not the environment. Levels found of one particular contaminant in farmed fish might be different than levels found in similar wild species caught at sea, rivers and lakes.

Since dioxins and DL-PCBs accumulate in fat, levels of those contaminants are found in much higher concentrations in the muscle meat of oily fish than lean fish. In some lean species, like cod, dioxins and DL-PCBs accumulate in the oily liver instead of the muscle meat. EU has chosen one single ML for dioxins and DL-PCBs for all fish (except eel) and fish products (except liver and brown meat from crustaceans). Including the huge variation of levels found in all fish species into one ML, it follows that the ML is much higher than levels actually found in many fish species (Figure 6). Consequently, in monitoring and control programmes the levels found in e.g. lean fish species will rarely exceed the ML, even if the fish are polluted above normal background levels.

For other contaminants, like methyl mercury and cadmium, there are several lists with fish species in the legislation which have two or three different MLs for the same contaminant. The Nordic group is of the opinion that the legislation should be as simple and straightforward as possible. On the other hand, fish is not a homogenous group, and if possible, the ML for dioxins and DL-PCBs for fish should be more in accordance with the different levels found in fish.

The Nordic group could not agree on how to lower MLs for fish in better accordance with true levels found. The following sections refer the discussion and different views among the participants in the working group.

6.2.1. Lean fish

In general, levels of dioxins and DL-PCBs in muscle meat of lean fish are low and lean fish do not make a significant contribution to the exposure. Since dioxins and DL-PCBs follow the fat, one way could be to separate fish into different groups accordingly to the fat content of the fish. This would lead to a discussion of where to set the cut off for fat levels (<1 %, <2 %, <5 % etc). The problem is that some fish species´ fat content differs during the year. Even species which normally are considered as oily fish (and therefore could contain a significant amount of dioxins and DL-PCBs) can be found with very low fat content. Some countries in the Nordic group were in favour of having separate MLs for lean fish and oily fish, other countries thought that it would be too complicated. The group also discussed the possibility of to exclude fish with very low fat level from having a ML (this is done for meat) or that fish species that store lipid in the liver could have separate ML or no ML for the fillet. No common Nordic conclusion could be obtained on this issue.

6.2.2. Oily fish

Nearly all fish samples, even oily fish (except fish from the Baltic), show levels of dioxins and DL-PCBs below 4 pgTEQ/g, which is half of the ML. Some Nordic countries believe that the ML for fish could be lowered substantially, even for oily fish. Theoretical intake estimates have shown that eating fish with dioxins and PCBs levels of 8 pg TEQ/g twice a month could alone contribute to approximately 70% of the TWI.

6.2.3. Eel

There has been found quite high levels of dioxins and DL-PCBs in eel. Still, the Nordic group is of the opinion that today’s ML is too high to protect public health. If the ML for eel is kept at this level, consumption advice to vulnerable group, like girls and young females at reproductive age, has to be given. It is quite difficult to communicate that eel could be put on the market in EU legally with a level of dioxins and DL-PCBs which is 50% higher than the general ML for fish, without any information or system in place to protect public health. Fish from the Baltic region cannot enter the marked in EU if levels of dioxins and DL-PCBs are exceeding the general ML for fish.

6.2.4. Farmed fish

Levels of dioxins and DL-PCBs in salmon, the most common farmed fish, are found at much lower levels than the ML. Reducing levels in farmed fish could also reduce the exposure in populations where farmed fish is a part of the diet, even for average consumers (see section 5.2.1.

Salmon). Some of the Nordic countries are in favour of setting a separate ML for farmed fish, others are in disfavour of such a separate level since it could be complicated to communicate out to the public that farmed fish has lower levels of dioxins and DL-PCBs than wild fish.

6.2.5. Fish liver

Fish liver, like cod liver, could contain high levels of dioxins and DL-PCBs. The Nordic group has not discussed this issue in detail in this project. Norway and Iceland have consumption advice to vulnerable groups, since fish liver traditionally have been eaten in those countries. It will probably be difficult to set a ML for fish liver which could be acceptable for human health point of view.

6.2.6. Derogation for some fish species from the Baltic

Finland and Sweden have derogation in the EU regulation setting MLs for dioxins and DL-PCBs until end of 2011 for some fish species from the Baltic Sea. Finland and Sweden have systems in place to handle this particular exposure problem. The Nordic group has no common view on this issue, and the involved countries should bring their own view into the negotiations. If the ML for fish is reduced substantially, it will affect more fish species from the Baltic.

5.3. Marine oils

The Nordic group thinks that ALARA and BAT principles should be considered when setting ML for marine oils. All marine oils intended for human consumption should be properly refined. Today's regulation allows unrefined oils to enter the marked in EU. Consumption of not properly refined marine oils could be a major contributor to the overall exposure of dioxins and DL-PCBs, especially among children (see Table 11). The Nordic group supports the statement in the EU Regulation 1881/2006 that the levels should be significantly lowered by the end of 2008. In order to reduce the exposure of dioxins and DL-PCBs from marine oils the MLs need to be reduced substantially.

5.4. Action levels

When EU was working with the regulation of dioxins and DL-PCBs in food, it was suggested to do this by an integrated approach. To reduce levels of dioxins and DL-PCBs in foods and therefore the exposure levels in the European population it was decided to use MLs, action levels and target levels in addition to monitoring. According to Commission recommendation 2006/88/EC the action levels are meant to be a tool for competent authorities in cases where it is appropriate to identify a source of contamination and take measures for its reduction or elimination. Action levels are typically set at 75% of the MLs. However, action levels have not given desired results, since only few reports on investigation of exceedence of action levels have been provided by the member states. Accordingly to the levels found in Nordic foodstuffs (see chapter 3) the action levels set by the recommendation (2006/88/EC) are probably not sufficiently low for the Nordic region.

The Nordic group therefore recommends that action levels should be reduced according to the levels found in foodstuffs in the Nordic countries. Furthermore, action levels should be used in a broader extent than today, in order for the authorities to take action to investigate and possibly eliminate the cause of any contamination above the action level.

5.5. Monitoring

A systematic monitoring of dioxins and DL-PCBs in foodstuffs for dioxins and DL-PCBs has been going on in EU since the beginning of 2000, and has increased the knowledge of dioxin and DL-PCB levels in food. The Nordic group thinks it is crucial to continue this monitoring. A database with results from dioxins- and DL-PCBs analysis in foods is necessary in order to calculate exposure from foods. It would be advantageous if the database with all data submitted to EU was made available for the competent authorities involved. Data from one country could be used in exposure assessment in another country if such data are lacking. This could in fact improve the intake estimates substantially.

Monitoring of breastmilk or blood is important in order to follow the time-trend in exposure to dioxins and DL-PCBs. Provided that the samples are from primiparous women at similar age; this is a more accurate measurement of the “true” exposure than dietary intake estimates.

5.6. Recommendations

- Substantially lower action levels set on national or regional basis could be a better tool than EU MLs to reduce exposure.
- The system to report levels exceeding the action levels and action taken should be improved
- ALARA principle should be considered when setting MLs for dioxins and DL-PCBs.
- For farmed fish and domestic animals it is most important to control the levels in feed.

- ML for eel should be reduced substantially and treated as other fish.
- Marine oil for human consumption should be refined with best available technology (BAT) and the ML should be reduced substantially.
- Monitoring of dioxins and PCBs in food and feed should be continued. This improves the knowledge and focus of levels in food, which can be used in intake calculations. Database with monitoring information should be made available to Member States.
- More extensive data on food consumption habits in the Nordic countries, preferably obtained in a harmonised way, is crucial for better estimates on intake in the Nordic countries.
- Improved monitoring of levels in blood or human milk should be carried out in order to follow the time trends of human exposure.

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Sammendrag 2 (Norsk)

Prosjektet ”Gjennomgang av grenseverdier for dioksiner og dioksinliknende PCB, innvirkning på eksponering og matvaretilgang”, koordinert av Norge, er et av tre prosjekter om dioksiner og dioksinliknende PCB som ble igangsatt og finansiert av Nordisk ministerråd i 2003/2004.

Mål ved prosjektet:

- Sammenstille og diskutere resultater fra nasjonale overvåkningsprogrammer og andre prosjekter som omhandler dioksiner og dioksinliknende PCB i de nordiske landene.
- Sammenstille inntaksberegninger av dioksiner og dioksinliknende PCB i de nordiske landene.
- Diskutere innvirkning på matvaretilgang ved forskjellige grenseverdier for dioksiner og dioksinliknende PCB og vurdere eksponering fra mat ved forskjellige grenseverdier for dioksiner og dioksinliknende PCB.
- Diskutere, og hvis mulig, konkludere om felles nordiske anbefalinger som kan brukes i de pågående forhandlingene om regleverket for dioksiner og dioksinliknende PCB i EU.

Prosjektgruppen bestemte seg for å lage en rapport som oppsummerte arbeidet. Rapporten innholder en historisk oversikt over hvordan de nordiske landene har vurdert og håndtert risiko knyttet til dioksiner, forekomstdata for dioksiner og dioksinliknende PCB i mat, en sammenlikning av inntaksberegninger i de nordiske landene, og diskusjoner av hvordan lavere grenseverdier vil påvirke eksponering og matvaretilgang. Rapporten inneholder også noen anbefalinger fra prosjektgruppen som kan brukes i diskusjonene som kommer når EU skal revurdere grenseverdiene for dioksiner og dioksinliknende PCB i mat.

Rapporten reflekterer diskusjonene som den nordiske prosjektgruppen hadde på sine møter. Konklusjonene og anbefalingene i rapporten representerer nødvendigvis ikke de offisielle synspunktene i de nordiske landene.

Prosjektgruppen har diskutert innvirkning på matvaretilgang i de nordiske landene og om dagens grenseverdier for dioksiner og dioksinliknende PCB reduseres med 25 %, basert på forekomstdata i de nordiske land som er presentert i rapporten. Denne reduksjonen ble valgt siden EU tidligere har presentert mulighetene for en slik prosentreduksjon. Arbeidet med dette nordiske prosjektet har vist at en reduksjon av EUs grenseverdier for dioksiner og dioksinliknende PCB for alle matvaregruppene med 25 % kun vil ha liten, hvis noen, innvirkning på matvaretilgangen eller eksponeringen.

For å undersøke innvrikning på eksponeringen, er det i tillegg estimert teoretiske inntak fra noen matvarer med mer realistiske nivåer av dioksiner og dioksinliknende PCB.

Det er viktig å være klar over at konklusjonene i rapporten er basert på få data og at kunnskap om nivåer i mat kan endres når flere data blir tilgjenglig gjennom overvåkningsprogrammene. Den nordiske prosjektgruppen tror ikke at grenseverdier er det beste verktøyet for å redusere eksponeringen for dioksiner og dioksinliknende PCB i de nordiske landene. Når grenseverdier i EU fastsettes skal alle medlemslandene høres, og forsjellige land har forskjellige kontamineringsnivåer i sin mat. De mest kontaminerte matvaregruppene i et land kan være forskjellig fra et annet land. Resultatet i forhandlingene i EU er at grenseverdier fastsettet ved nivåer som kun ekskluderer de mest forurensede matvarene fra markedet. Den nordiske prosjektgruppen tror derfor at bruk av atskillig lavere tiltaksgrenser (action levels), enn de som eksisterer i dag, kan være et viktig verktøy for redusere eksponeringen av dioksiner og dioksinliknende PCB den nordiske befolkningen.

Som en overordnet konklusjon er den nordiske prosjektgruppen enig om at ALARA-prinsippet (så lavt som rimelig mulig) bør vurderes når grenseverdier skal fastsettes. Bruk av ALARA er nedfelt i EU-reguleringen, og dette prinsippet er også det viktigste verktøyet for å unngå at forurenset mat når markedet i EU. Siden grenseverdiene for dioksiner og dioksinliknende PCB i de fleste tilfellene er høyere enn de aktuelle nivåene som finnes i mat i de nordiske landene, kan det synes som at EUs grenseverdier ikke følger ALARA-prisnippet for de fleste matvarer fra de nordiske landene.

Det er vanskelig å kommunisere at det er nødvendig å gi kostholdsråd for visse matvarer, selv om nivåene av dioksiner og dioksinliknende PCB er under fastsatte grenseverdier. En annen bekymring blant de nordiske landene er at når grenseverdiene er satt mye høyere enn nødvendig, kan mat fra andre land som inneholder høyere nivåer av dioksiner og dioksinliknende PCB lovlig importeres, noe som kan medføre høyere eksponering i befolkningen (et eksempel er marine oljer).

For oppdrettsfisk og husdyr vil nivåene av dioksiner og dioksinliknende PCB reflektere nivåene som finnes i fôret og i mindre grad være påvirket av miljøet. Den mest effektivt måtene å redusere nivåene i disse matvarene vil være å regulere og senke nivåene i fôret.

Den nordiske prosjektgruppen kunne ikke enes om hvordan grenseverdiene i villfisk og oppdrettsfisk burde reduseres slik at de blir i bedre samsvar med faktiske nivåene som er funnet. Diskusjonene i gruppen er referert i rapporten.

En annen konklusjon fra den nordiske prosjektgruppen er at det fortsatt er nødvendig å prøve å redusere eksponeringen av dioksiner og dioksinliknende PCB i de nordiske landene, i det minste blant enkelte undergrupper i befolkningen. Alle de nordiske landene har kostholdsråd, som et risikohåndteringstiltak, for å redusere eksponeringen av dioksiner og dioksinliknende PCB i befolkningen. Det vil alltid være spørsmål knyttet til hvor effektive slike råd er. Hvis grenseverdiene i EU fortsatt blir opprettholdt for høye, vil det muligens bli behov for å utvide kostholdsrådene i de nordiske landene, noe som igjen vil komplisere risikokommunikasjonen.

Anbefalinger

- Betydelige lavere tiltaksgrenser som er fastsatt på nasjonalt eller regionalt nivå kan være et bedre verktøy enn EUs grenseverdier for å redusere eksponeringen.
- Systemet for å rapportere overskridelse av tiltaksgrenser og hvilke tiltak som gjøres bør utbedres.
- ALARA-prinsippet bør tas med i betraktning når grenseverdier for dioksiner og dioksinliknende PCB fastsettes.
- For oppdrettsfisk og husdyr er det viktigst å kontrollere nivåene i fôr.
- Grenseverdien for ål bør reduseres betydelig og ål bør behandles som annen fisk.
- Marine oljer for humant konsum bør være renset med best tilgjenglig teknologi (BAT) og grenseverdien bør reduseres betydelig.
- Overvåkning av dioksiner og dioksinliknende PCB i mat og fôr bør videreføres. Dette opprettholder fokus på og bedrer kunnskapen om nivåer i mat, som igjen kan benyttes i inntaksberegninger. En database med resultater fra overvåkningen bør bli tilgjengelig for medlemslandene.
- Mer omfattende opplysninger om matinntak og matvaner, som helst burde være innsamlet med harmoniserte metoder, er viktige for å få bedre inntaksestimater i de nordiske landene
- Forbedret overvåkning av nivåer i blod og morsmelk bør gjennomføres for å følge tidstrender for human eksponering.

Appendices

Appendix I: Intake estimates

Description of the intake estimates from each country is presented in this appendix. The sub-chapter for each country starts with the occurrence table that was filled in and submitted in connection with the project. Then follows a description of surveys on which calculations are based.

Denmark

Table A1: Intake estimates for dioxins and DL-PCBs in Denmark

Denmark											
			pg WHO-TEQ/kg bw/day								
		g/d	**dioxins**			**dl PCBs**			**Dioxins + PCBs**		
Food			**mean**	**median**	**95th perc**	**mean**	**median**	**95th perc**	**mean**	**median**	**95th perc**
Fish	Oily										
	Baltic oily										
	Other										
	Shell-fish										
	Fish SUM		0,12	0,05	0,46	0,19	0,07	0,75	0,31	0,11	1,2 1)
			0,16	0,05	0,64	0,26	0,07	1,2	0,42	0,12	1,8 2)
			0,23	0,06	1,1	0,40	0,08	2,1	0,63	0,14	3,2 3)
Meat			0,083	0,077	0,16	0,064	0,058	0,13	0,15	0,14	0,29
Dairy products			0,18	0,16	0,36	0,15	0,14	0,31	0,33	0,30	0,67
Vegetable oils											
Other fats											
Eggs			0,02	0,01	0,04	0,02	0,01	0,04	0,03	0,03	0,09
Other											
*Sum all**			0,40	0,35	0,80	0,42	0,33	1,0	0,82	0,67	1,8 1)
			0,43	0,36	0,95	0,49	0,34	1,4	0,92	0,68	2,4 2)
			0,50	0,36	1,4	0,63	0,34	2,3	1,1	0,70	3,7 2)

*) Dairy products include milk fat from butter and other fats
1) The salmon part of the fish intake has TEQ dioxin = 1 pg/g and TEQ PCB = 2 pg/g (low level)
2) The salmon part of the fish intake has TEQ dioxin = 2 pg/g and TEQ PCB = 4 pg/g (intermediate level)
3) The salmon part of the fish intake has TEQ dioxin = 4 pg/g and TEQ PCB = 8 pg/g (MRL level)

Description and explanation of the Danish intake estimation

The intake estimates are based on the dietary intake data collected in the Danish nationwide food consumption survey 2000-2002 (1). The food consumption data were sampled throughout the 3 years in order to take into account any possible seasonal variation in dietary habits. The representative sample of Danes included a total of 4120 respondents (2167 female and 1953 male) aged 4-75 yr. The Danish nationwide food consumption survey used a seven-day prospective food record with a pre-coded (semi-closed) questionnaire that included answering categories for the most commonly eaten foods and dishes in the Danish diet.

The questionnaire was organised according to a normal daily meal pattern. For food items not found in the pre-coded categories, it was allowed for the participant to manually fill in the missing food. The food amounts eaten were given in household measures, e.g. pieces, glasses, cups, spoons, etc. Standard portion sizes were used in the conversion of the reported amounts to weight (grams). Composite foods (e.g. dishes) were split up into ingredients by means of standard recipes. Due to the simplified design of the questionnaire, the total diet could be represented by the intake of 333 food items with Food Identification numbers (FoodId). The final result of these conversions was then recalculated and expressed as the daily mean intake for the seven-day food register of each participant in the survey.

Based upon the individual's data, it was possible to describe the intake distribution of both foods and chemical contaminations for the population divided into children (e.g. 4-14 years of age) and adults (15-75 years of age).

For calculations of the intake of contaminants in this report, the individual-level consumption of each of the food items was multiplied by a qualified estimate of the contaminant content in that particular food item. The result of this is a distribution of the contaminant intake among adults or children. The intake distribution within the population has been described using an average as well as the 90%-quantile for high intakes. The bodyweight of the individual respondents was used in those cases where the result of the intake calculation is stated as intake per kg bodyweight.

Dioxins and dioxin-like PCB accumulates in fatty tissue and this fact is the basis for allocation of a figure of content to the many type of food item in the consumption survey despite the relatively few type of foodstuffs analysed in the monitoring programme.

The Danish action plan for dioxins started in 2000 and ended in 2004. The samples were taken from 2000 to 2004 and the intake calculations were carried out using the average contents in the analysed foodstuffs from the period (2 and 3). In Table A2 the sampling plane is shown.

Table A2: Sampling plane for analyses of dioxins and DL-PCBs in food and human milk in the period 2000-2004.

	2000	2001	2002	2003	2004	2000-2004
Pigs	5	5	5	10	10	35
Bovine	5	5	5	10	10	35
Sheep		5	5	10	10	30
Poultry	5	5	5	26	29	70
Hens Eggs	5	5	10	3	20	43
Cows milk	5	5	5	4	20	39
Dairy products		10			6	16
Fruit, vegetables and cerials					15	15
Vegetable oils					6	6
Aquaculture	5		5	10	10	30
Wild fish	5		20	15	12	52
Fish oils – dietary supplements	5				9	14
Human milk	19[1]		19		13	51
Number of samples in total	**59**	**40**	**79**	**88**	**170**	**436**

[1]The samples are collected in 1999

Table A3 summarises the calculated estimates for daily intakes. There are two sets of calculations. One with the calculated intake from food excluding fish and another where fish is included and the salmon part of the intake has been given three different levels of dioxins and PCB contents (as described previously).

Table A3: Calculated estimates for daily intakes of dioxins and dioxin-like PCB in the Danish population.

Dioxin and dioxin-like PCB	pg WHO-TEQ/kg bw/day Average	95% percentile
Food excluding fish		
Adults	0.51	0.91
Children age 4-14	1.1	2.0
Children age 4-6	1.5	2.4
Food including fish		
Adults – salmon at relative low levels of dioxins	0.82	1.8
Adults – salmon at middle levels of dioxins	0.92	2.3
Adults – salmon at maximum levels of dioxins	1.1	3.7

For the calculation excluding fish, intake figures by adults as well as children have been obtained. It appears that children because of the relatively large food intake compared to their bodyweight have two to three times the daily intake of dioxins and dioxin-like PCB than adults. The 95%-percentile for children is close to or exceeds the Tolerable weekly intake (TWI) at 14 pg WHO-TEQ/kg bw/week (which is equivalent to 2 pg WHO-TEQ/kg bw/day).

To account for the difficulties in selecting the true composition of fish meal with regards to catching area and thereby level of contamination, the intake from food, including fish, has been carried out by setting the contents of dioxins and PCB in salmon to three different levels. The calculations show that the average intake of dioxins and dioxin-like PCB for adults are close to 50% of TWI. Consumers with high dietary intake of dioxins and dioxin-like PCB are close to or exceed TWI.

The contribution from the main food groups to the average intake is 30-40% from milk or milk products, 3-4% from eggs, 13-18% from meat and 38-55% from fish.

References:

(1) Danskernes kostvaner 2000-2002. Hovedresultater. Danmarks Fødevareforkning 2005. (Available at www.food.dtu.dk)

(2) Dioxinhandlingsplan 2000-2004, slutrapport 4. maj 2005. Danmarks Fødevareforskning. (Available at www.food.dtu.dk)

(3) Chemical contaminants. Food monitoring 1998-2003. Fødevarerapport 2005:01. Danish Veterinary and Food Adminstration. (Available at www.food.dtu.dk)

Finland

Table A4: Intake estimates for dioxins and DL-PCBs in Finland

Finland										
			pg WHO-TEQ/kg bw/day							
Food		**g/d**	**Dioxins**			**dlPCBs**			**Dioxins + PCBs**		
			mean	**median**	**95% perc.**	**mean**	**median**	**95% perc.**	**mean**	**median**	**95% perc.**
Fish	oily [*1]	11.5	0.0892			0.204			0.293		
	Baltic oily[*2]	3.7	0.324			0.172			0.496		
	other	19.8	0.157			0.319			0.477		
	Shell-fish	-	-			-			-		
	Fish SUM	35	0.571			0.695			1.27		
Meat		126	0.0498			0.0326			0.0824		
Dairy products		385	0.0388			0.0223			0.0611		
Vegetable oils		5.7	0.0113			0.00251			0.0138		
Other fats		-	-			-			-		
Eggs		27	0.0172			0.0148			0.0320		
Other		292	0.00475			0.00925			0.014		
Sum all		871	0.693			0.777			1.47		

*1. includes farmed rainbow trout, farmed whitefish, wild whitefish, and vendace

**2. includes Baltic herring, wild salmon, and wild whitefish*

Description and explanation of the Finnish intake estimation

Due to consumption data Finland is able to report only the mean values of each intake. There are four intake studies conducted in Finland from early 1990s to current days.

The first (1) one included only dioxins. The average food comsumption data originated from the National Public Health Institute's (KTL) dietary study in 1992 was utilized in this study. The dioxin occurrence study was based on lower bound concentrations and the daily intake of dioxins was estimated to be 95 pg Nordic-TEQs. This first and also the second intake study were based on selected study of individual foodstuffs.

The second (2) study was conducted in late 1990s and the PCBs were for the first time included to the assessment. The average food consumption data was again obtained from the KTL's dietary survey and this time from the year 1995 (3). Dietary data was based on the 24-h recall study, and it included 2862 Finnish general population adults. The intake estimate was again done by using lower bound concentrations of dioxins and PCBs, but there was some discussion in the article about intakes obtained by using upper bound concentrations. The daily intake was assessed to be 100 pg I-TEQ including both dioxins and PCBs. It must be noted that the PCB occurrence data in this study was limited.

The third study of dioxin and PCB intakes in Finland was based on market baskets (4). The food consumption data in this study originated from the same dietary study by KTL as was utilized in the previous intake assessment. In this market basket study the intakes were estimate by both, lower and upper bound concentrations. The most comparable intake estimates in this market basket study with the previous study showed a daily intake of 108 pg I-TEq. When the upper bound concentrations and the new WHO-TEQs were used in the assessment the daily intake was estimated to be 114 pg WHO-TEQ.

The fourth study of Finnish intake of dioxins and PCBs is presented in this report. The food consumption data was obtained from the KTL's dietary survey from the year 2002 (5). Dietary data was based on the 48-h recall study, and it included 2007 Finnish general population adults.

The fifth intake study is already available and published in the Finnish scientific publication, Duodecim. The newest data give specified information of contaminant exposure from different fish species that has not been known earlier.

Table A5: Exposure of dioxins and dioxin-like PCBs from food groups, Finland 2005

Food group	Consumption g/day	Fat g/day	Daily intake, dioxins, pg WHO-TEQ	Daily intake, PCBs, pg WHO-TEQ	Intake sum pg WHO-TEQ	% of total intake
Milk and milk products	385	12.8	3.00	1.73	4.73	4.2
Eggs	27	2.5	1.33	1.15	2.48	2.2
Salt-water fish*	6.29		28.91	18.80	47.71	42.0
Inlake fish*	6.30		4.36	4.84	9.20	8.1
Farmed domestic fish*	4.47		2.08	7.20	9.28	8.2
Imported fish*	17.65		8.83	22.95	31.77	27.9
Fish together*	34.71		44.18	53.79	97.96	86.2
Meat and meat products	126.10	15.4	3.86	2.52	6.38	5.6
Vegetable oils*	5.7	5.7	0.87	0.19	1.06	0.9
Others*	292		0.37	0.72	1.08	0.9
(flours, potatoes, vegetables, blueberry, chantarelle)			53.61	60.10	113.70	
* For fresh weight						

Table A6: Finnish data on dioxins and PCBs in breast milk, primparae mothers

Primiparae mothers						
1987	**Mean**	**Median**	**Min**	**Max**	**n**	
PCDD/F	359,3	343,0	162,6	768,2	84	pg/g fat
$WHO_{PCDD/F}$-TEQ	27,63	26,28	12,51	111,9	84	pg/g fat
PCB	452,0	451,5	139,6	1624	84	ng/g fat
marker-PCB	307,9	305,6	96,78	1025	84	ng/g fat
WHO_{PCB}-TEQ	28,91	25,51	7,24	148,1	84	pg/g fat
1993-94	**Mean**	**Median**	**Min**	**Max**	**n**	
PCDD/F	284,7	249,9	117,8	558,6	31	pg/g fat
$WHO_{PCDD/F}$-TEQ	19,08	17,92	7,272	39,00	31	pg/g fat
PCB	254,6	234,2	73,85	464,4	31	ng/g fat
marker-PCB	179,6	171,2	49,30	331,6	31	ng/g fat
WHO_{PCB}-TEQ	13,36	12,36	3,957	30,04	31	pg/g fat
1995	**Mean**	**Median**	**Min**	**Max**	**n**	
PCDD/F	192,7	210,0	82,69	246,7	8	pg/g fat
$WHO_{PCDD/F}$-TEQ	16,21	16,17	7,541	22,18	8	pg/g fat
PCB	192,7	193,9	89,57	293,8	8	ng/g fat
marker-PCB	136,1	138,1	64,42	195,9	8	ng/g fat
WHO_{PCB}-TEQ	9,906	9,001	3,899	16,31	8	pg/g fat
1996-97	Mean	Median	Min	Max	n	
PCDD/F	206,1	172,2	65,24	895,8	28	pg/g fat
$WHO_{PCDD/F}$-TEQ	15,53	12,79	7,035	52,70	28	pg/g fat
PCB	198,7	193,1	61,95	653,3	28	ng/g fat
marker-PCB	142,7	136,8	43,93	477,1	28	ng/g fat
WHO_{PCB}-TEQ	11,36	9,628	3,564	36,59	28	pg/g fat
2000	**Mean**	**Median**	**Min**	**Max**	**n**	
PCDD/F	163,1				2 pools	pg/g fat
$WHO_{PCDD/F}$-TEQ	9,436				2 pools	pg/g fat
PCB					2 pools	ng/g fat
marker-PCB	91,00				2 pools	ng/g fat
WHO_{PCB}-TEQ	5,845				2 pools	pg/g fat

Table A7: Finnish data on dioxins and PCBs in breast milk, all mothers

Concentrations of dioxins and PCBs in Finnish breast milks between 1987 and 2000

All mothers

1987	**Mean**	**Median**	**Min**	**Max**	**N**	
PCDD/F	323,9	299,6	91,99	768,2	167	pg/g fat
$WHO_{PCDD/F}$-TEQ	23,51	22,69	4,625	111,9	167	pg/g fat
PCB	391,7	357,9	59,76	1624	167	ng/g fat
marker-PCB	266,3	252,5	39,37	1025	167	ng/g fat
WHO_{PCB}-TEQ	25,32	22,25	3,201	148,1	167	pg/g fat
1993-94	**Mean**	**Median**	**Min**	**Max**	**N**	
PCDD/F	233,4	204,4	51,64	558,6	84	pg/g fat
$WHO_{PCDD/F}$-TEQ	15,08	14,09	1,977	39,00	84	pg/g fat
PCB	204,4	193,0	52,60	464,4	84	ng/g fat
marker-PCB	143,0	136,9	32,34	331,6	84	ng/g fat
WHO_{PCB}-TEQ	10,22	8,948	1,605	30,04	84	pg/g fat
1995	**Mean**	**Median**	**Min**	**Max**	**N**	
PCDD/F	192,7	210,0	82,69	246,7	8	pg/g fat
$WHO_{PCDD/F}$-TEQ	16,21	16,17	7,541	22,18	8	pg/g fat
PCB	192,7	193,9	89,57	293,8	8	ng/g fat
marker-PCB	136,1	138,1	64,42	195,9	8	ng/g fat
WHO_{PCB}-TEQ	9,906	9,001	3,899	16,31	8	pg/g fat
1996-97	**Mean**	**Median**	**Min**	**Max**	**n**	
PCDD/F	206,1	172,2	65,24	895,8	28	pg/g fat
$WHO_{PCDD/F}$-TEQ	15,53	12,79	7,035	52,70	28	pg/g fat
PCB	198,7	193,1	61,95	653,3	28	ng/g fat
marker-PCB	142,7	136,8	43,93	477,1	28	ng/g fat
WHO_{PCB}-TEQ	11,36	9,628	3,564	36,59	28	pg/g fat
2000	**Mean**	**Median**	**Min**	**Max**	**n**	
PCDD/F	163,1				2 pools	pg/g fat
$WHO_{PCDD/F}$-TEQ	9,436				2 pools	pg/g fat
PCB					2 pools	ng/g fat
marker-PCB	91,00				2 pools	ng/g fat
WHO_{PCB}-TEQ	5,845				2 pools	pg/g fat

Table A8: Finnish data on dioxins and PCBs in adipose tissues

Concentrations of dioxins and PCBs in Finnish adipose tissue in 1997-1999

General population, with 51% females

1997-1999	**Mean**	**Median**	**Min**	**Max**	**n**	
PCDD/F	413	364	78,0	2080	420	pg/g fat
$WHO_{PCDD/F}$-TEQ	29,0	24,1	3,64	153	420	pg/g fat
$PCB_{37\ congeners}$	502	437	63,2	3240	420	ng/g fat
marker-PCB	343	294	43,4	2360	420	ng/g fat
WHO_{PCB}-TEQ	20,7	16,7	2,46	129	420	pg/g fat
age	44	44	13	81	420	years

References:

(1) A. Hallikainen and T. Vartiainen. 1995. Food control surveys of polychlorinated dibenzo-*p*-dioxins and dibenzofurans and intake estimates. *Food Additives and Contaminants* 14 (4): 355-366.

(2) H. Kiviranta, A. Hallikainen, M.-L. Ovaskainen, J. Kumpulainen and T. Vartiainen. 2001. Dietary intakes of polychlorinated dibenzo-*p*-dioxins, dibenzofurans and polychlorinated biphenyls in Finland. *Food Additives and Contaminants* 18 (11): 945-953.

(3) National Public Health Institute, Department of Nutrition. 1998. The 1997 dietary survey of Finnish adults, *Publications of the National Public Health Institute B8/1998*.
(4) H. Kiviranta, M.-L. Ovaskainen and T. Vartiainen. 2004. Market basket study on dietary intake of PCDD/Fs, PCBs, and PBDEs in Finland. *Environment International* 30: 923-932.
(5) S. Männistö, M.-L. Ovaskainen and L. Valsta. 2003. The National Findiet 2002 study. *Publications of the National Public Health Institute B3/2003*.

Iceland

Description and explanation of the Icelandic intake estimation

The Diet of Icelanders. Dietary Survey of The Icelandic Nutrition Council 2002. Website:

http://lydheilsustod.is/media/manneldi/rannsoknir/skyrsla.pdf)

Table A9: Iceland – intake of dioxins – fish products

	mean consumption/day	mean PCDDs/Fs (pg)	mean DL-PCBs (pg)
fresh ocean fish	29.0 g	1.62 ± 3.72	5.65 ± 12.93
salted fish	4.51 g	0.04 ± 0.17	0.18 ± 0.84
Shellfish	3.95 g	0.15 ± 0.92	0.24 ± 1.49
Farmed fish	2.55 g	0.70 ± 5.51	2.1 ± 16.1
cod liver oil	1.26 g	0.22 ± 0.52	2.7 ±6.55
total fish and fish products	**41.3 g**	**2.7 ± 7.5**	**10.8 ± 24.3**
Total dioxins: PCDDs/Fs + DL-PCBs= 13.54 pg/day			

Table A10: Iceland – intake of dioxins – other food groups

	mean consumption/day	mean PCDD/Fs (pg)	mean DL-PCBs (pg)
milk and milkpr.	296.1 g	0.89 ±0.99	1.95±2.17
sour milk and milkpr	90.9 g	0.55 ±0.88	1.20 ±1.94
eggs	11.1 g	0.31 ±0.87	1.39 ±3.90
beef.	20.4 g	0.43 ±0.91	1.02 ±2.17
lamb	25.2 g	0.68 ±1.82	0.63 ±1.69
cheese	36.2 g	1.41 ±1.64	3.11 ±3.62
pork	10.9 g	0.27 ±1.15	0.32 ±1.33
chicken	15.1 g	0.23 ±0.76	0.91 ±3.04
Total		4.8 ± 3.1	10.5 ± 7.12
Total dioxins: PCDDs/Fs + DL-PCBs=	15.28 pg/day		

- Total dioxin from fish and fishproducts:
- 13.5 pg/76 kg = 0.18 pg/kg
- Total dioxin from other foodgroups:
- 15.3pg/76 kg = 0.20 pg/kg

- Total consumption of dioxins/day:
- 0.18 pg/kg + 0.20 pg/kg = 0.38 pg/kg

Table A11: PCB6 in mothers serum in Iceland

year	n	Age	PCB6*
1995	**40**	**29,1**	**1,28 (1,37)**
1999	**39**	**28,3**	**1,20 (1,35)**
2004	**40**	**30,3**	**0,76 (0,81)**

* PCBs; 28, 52, 101, 138, 153, 180, geom mean (arr.mean)

Norway

Table A12: Intake estimates for dioxins and DL-PCBs in Norway

Country: Norway											
			pg WHO-TEQ/kg bw/day								
	Food	**g/d**	**dioxins**			**dlPCBs**			**Dioxins + PCBs**		
			mean	**median**	**95% perc.**	**mean**	**medi-an**	**95% perc.**	**mean**	**medi-an**	**95% perc.**
	oily	18							0.41	0.32	0,99
	Baltic oily	-									
	other	39							0.28	0.15	
	Shell-fish	10							0.11	0.04	
Fish	*Fish SUM*	70							0.80	0.67	1,94
Meat		106							0,22	0.20	0.43
Dairy products		497							0.15	0.12	0.32
Vegetable oils									0.16	0.11	0.43
Other fats											
Eggs		17							0.06	0.05	0.14
Other									0.05	0.05	0.13
Sum all									1.43	1.20	3.32

Description and explanation of the Norwegian intake estimation

Intake of dioxins and dioxin-like PCBs among Norwegians are based on analytical data on dioxins and dioxin-like PCB in different food commodities from 1999-2004 (medium bound results) combined with data from food consumption. None of the estimated exposures have been validated using biomarkers of dioxin exposure.

The data on food consumption among adults were obtained from the national dietary survey NORKOST 1997 (1) and the Norwegian Fish-and Game Study, part A 1999 (2). Among children food consumption data are from the national dietary survey UNGKOST 2000 (3).

In NORKOST 1997 a sample of 2 672 persons in the age of 16 to 79 years participated (average body weight=73 kg). The method used in NORKOST was a quantitative food frequency questionnaire, which was distributed and collected in four different periods spread through the year. The survey tries to capture information about the usual diet during the prior year among the participants.

One of the weaknesses regarding the survey NORKOST 1997 is that the questionnaire, on which the data are based, only includes four questions regarding fish consumption ("How often do you eat oily fish, lean/semi-oily fish, freshwater fish and shellfish?"). Thus, the data do not give detailed information about the consumption of specific fish species (ref Christina Bergsten, personal communication). Therefore, the calculated exposure from fish was replaced by data from the Norwegian Fish and Game Study, part A.

The Norwegian Fish and Game Study, part A, was carried out in November 1999 on a nation-wide randomly chosen sample of 10 000 individuals. Of these, 6015 adults answered a food frequency questionnaire, which included 25 questions about the consumption of fish and shellfish. The findings from part A provided information about fish and game consumption in the general population (2). The food consumption data were combined with occurrence data in fish (4). In the new calculation (Table A13) the estimated average and median intake of dioxins and dioxin-like PCBs from fish and shellfish based on Fish and Game Study was added to the intake based on NORKOST 1997 from all of the other food (milk, egg, cereal products, etc) except fish and shellfish. High intake (95-percentile) was estimated by combining 95-percentile intake from the Fish- and game study with median intake from other food as calculated from NORKOST 1997. This combined intake estimate from two different studies is considered to provide a result that is closer to the "true" intake of dioxin and dioxin-like PCBs than the intake based on data from NORKOST 1997 solely.

Table A13: Estimated intake of dioxins and dioxin-like PCBs among adults.

Study	Average pg TEQ/kg body weight/week	Median pg TEQ/kg body weight/week	95-percentile pg TEQ/kg body weight/week
Norkost 1997	(7.7)	*(6.5)*	*(15.2)*
Norkost 1997, fish and shellfish not included	*4.4*	3.9	8.3
Fish- and game study part A	5.6	4.7	13.6
*Total**	10.0	8.6	17.5

It has been estimated that approximately 15% of Norwegians have a higher exposure than EU's TWI of 14 pg TEQ/kg body weight/week (*4*).

UNGKOST 2000 was carried out in Norway in the period of 2000-2001. The sample consisted of children in the age of 4 years (n=391), 9 years (n=810) and 13 years (n=1005). The methodology used was a precoded 4-d record and data refer to food as consumed with weight of food using photographs of foods items. Estimated TEQ-exposure from the total diet is presented in table A14.

Table A14: Estimated average (95-percentile) intake of dioxins and dioxin-like PCBs among Norwegian children. Data are expressed as pg TEQ/kg body weight/week.

Population group	Children. 13 years	Children. 9 years	Children. 4 years
Estimated intake mean (95-perc)	6.7 (14.7)	10.6 (23.8)	15.3 (32.6)

Results from the intake calculation showed that the estimated average intake among 4-year old children is slightly above TWI, whereas the estimated average intake among 13-year old children is approximately half of the TWI.

Estimated high intake (95^{th} percentile) of dioxins and dioxin-like PCBs are close to or higher than TWI for all children.

References

1. Johansson, L. and Solvoll, K. (1999) NORKOST 1997. Landsomfattende kostholdsundersøkelse blant menn og kvinner i alder 16-79 år, 2/1999 ed., Statens råd for ernæring og fysisk aktivitet.
2. Meltzer, H., Bergsten, C., and Stigum, H. (2002) Fisk og viltundersøkelsen. Konsum av matvarer som kan ha betydning for inntaket av kvikksølv, kadmium og PCB/dioksin i norsk kosthold, SNT-rapport 6, 2002 ed..
3. Øverby, N. C. and Andersen, L. F. (2002) Ungkost 2002. Landsomfattende kosholdsundersøkelse blant elever i 4.- og 8. klasse i Norge., Sosial- og helsedirektoratet, Avdeling for ernæring.
4. VKM (2007) New WHO TEFs for dioxins and dioxin-like PCBs:
5. Assessment of consequence of altered TEF values for dioxins and dioxin-like PCBs on current exposure in the Norwegian population.

Sweden

Table A15: Intake estimates for dioxins and DL-PCBs in Sweden

Country: Sweden											
			pg WHO-TEQ/kg bw/day								
Food		g/d*	Dioxins			dlPCBs			Dioxins + PCBs		
			mean	medi-an	95% perc.	mean	medi-an	95% perc.	mean	median	95% perc.
Fish	oily	10	0.086	0.043	0.240	0.124	0.078	0.388	0.192	0.109	0.623
	Baltic oily	4.4	0.212	0.087	0.872	0.158	0.062	0.603	0.384	0.157	1.530
	other	21	0.045	0.037	0.122	0.060	0.051	0.150	0.106	0.088	0.271
	Shell-fish	3.8	0.044	0.011	0.112	0.023	0.006	0.058	0.067	0.016	0.171
	Fish SUM	38	0.387	0.237	1.175	0.365	0.253	1.041	0.749	0.482	2.265
Meat		103	0.074	0.058	0.188	0.059	0.051	0.127	0.133	0.118	0.283
Dairy products		390	0.106	0.095	0.223	0.083	0.074	0.176	0.189	0.169	0.399
Vegetable oils		10	0.058	0.042	0.165	0.028	0.020	0.081	0.109	0.079	0.299
Other fats		14	0.075	0.067	0.177	0.037	0.033	0.087	0.113	0.101	0.264
Eggs		12	0.007	0.004	0.023	0.005	0.003	0.016	0.011	0.006	0.039
Other		-	-	-	-	-	-	-	-	-	-
Sum all			0.707	0.567	1.561	0.577	0.475	1.290	1.304	1.068	2.852

Description and explanation of the Swedish intake estimation

General

Regular environmental monitoring of persistent organic pollutants is carried out within the framework of the national environmental monitoring programme (Miljöövervakningen) operated by the Swedish Environmental Protection Agency. It includes amongst other things programme for surveying dioxins and dioxin-like compounds and their sources. The main emphasis of the programme is on the marine sector where high levels are usually found. Sampling, analyses and intake calculations of dioxins in food made by Swedish NFA have partly been supported by the Swedish EPA.

A special effort was made in years 2000-2003 to investigate the situations regarding dioxin levels in fish from the Baltic region. Some 120 PCDD/DF dioxin analyses were performed of both pooled and single samples, and the result was presented on NFA:s web site (www.slv.se; seach "dioxin") as five interim reports. In one of those (no 5), total TEQ were calculated for 67 of the fish samples. These analyses were partly financed by the Government.

In addition, the Swedish NFA yearly (since 2003) measures dioxins in a number of food samples as part of the surveillance activities in controlling the dioxin maximum limits. The main part consists of fish and meat samples, but also vegetable samples have recently been collected.

The samples

The samples used as the basis for the intake calculation,

With their resulting dioxin levels, are given in Table A17. In Table A18a, the portion sizes for fish used in the intake calculations are given, and in Table A18b list the fish species used in the calculation of intake from certain fish categories.

Analytical methodology and Quality Assurance

Most of the analyses have been performed at the Department of Environmental Chemistry, University of Umeå, but some analyses have also been purchased from commercial labs abroad.

The Umeå laboratory has at different occasions participated in interlaboratory trials of measurement of dioxins and PCBs in various biological materials organised by the WHO, ICES and IUPAC and have recognised expertise in the analysis of foods for dioxins and PCBs. The quality control criteria were as described by Lindström and Rappe (1) and included the use of certified standards, continuous monitoring of blank samples and recovery qualification criteria of 50-150%.

Food consumption data

The food consumption data used in the intake calculations are derived from the latest national dietary survey, Riksmaten 1997-98 (2). The methodology used was a precoded 7-d records and data refer to food as consumed, i.e. no back-calculation to recipe ingredients has been done. The data refer to males and females 18-74 year old. The PCB and dioxin data have been adjusted to the fat content of the foods. For fish data, the consumption data are derived from a food frequency questionnaire covering consumption during the previous year. Standard portions have been used to estimate the average daily fish consumption. Analytical data are available for the most important fish species, and these data have been matched with the appropriate category in the questionnaire

Table A16: Body weights for the study populations

	Riksmaten 1997-98
Males	80.8
Females	66.6

Table A17. Origin (type of food sample), dioxin level (DD/DF + DL-PCB) and year of sampling for the analysed food samples. The levels are based on fresh weight except for dairy products, butter, game, beef, pig and fowl where fat weights are used. The TEQ-levels are calculated by use of ½LOD in case the levels were under the quantification limit

Food commodity	Type of food sample for analyse	TEQ-level pg/g	Sampling year
Dariy products (except for butter)	Milk from the NFA control programme for POPs	0.98	2003
Butter	Single food item from the Market Basket 1999	0.59	1999
Margarine (vegetable fat)	Fat mix from the Market Basket 1999 (Uppsala; margarine and cooking oil)	0.61	1999
Pig meat	Pig fat from the NFA control programme for POPs	0.19	2003
Cow meat	Cow fat from the NFA control programme for POPs	1.45	2003
Game meat	Dear meat from the NFA control programme for POPs.	3.50	1998
	Analysed in connection to the Market Basket project 1999		
Liver pate	Single food item from the Market Basket 1999	0.61	1999
Sausage	Meat mix from the Market Basket 1999 (Uppsala; mix of whole and cured meats)	0.08	1999
Kidney/liver	Calf liver from the NFA control programme for POPs	0.14	2003
Chicken meat	Chicken fat from the NFA control programme for POPs	0.65	2004
Eggs	Egg samples from the NFA control programme for POPs	0.18	2003-2004
Lean sea fish (fresh, frozen)	Cod – occurrence level from fish project	0.47	2002
	This level has been used for att lean sea fish. as cod. plaice. saithe		
Herring	Herring från Rügen. and data from the Norwegian control programme	1.53	2002-2004
Baltic herring (incl. smoked)	Occurrence levels from fish project	10.4	2000-2002
	Weighted data from four catchment areas		
Baltic salmon	. Occurrence levels from fish project	10.4	2000-2002
Other salmon	Occurrence levels on farmed Norwegian salmon. from fish project	2.1	2001
Lean lake fish	Pike – single food item from Market Basket 1999	1.3	1999
	Occurrence levels on pike was used for other lean lake fish		
	(perch. pike-perch. burbot)		
Shellfish	Occurrence levels from fish project	1.26	2001
Maquerel	Occurrence levels from fish project	1.55	2001
Eel	Occurrence levels from fish project	4.65	2000-2002
Sardine	Extrapolated value – mean value of levels in West coast herring and cod.	0.99	1998, 1999
	Analysed in connection to Market Basket 1999		
Tune	Extrapolated value – from cod. Analysed in connection to Market Basket 1999	0.31	1999
Other canned fish /fish roe	Extrapolated value – mean value of levels in sardine. tuna and maquerel	0.95	1999
			2001
Fish liver	Burbot liver	101.5	1989

Table A18a: Fish species and portions sizes used in the intake calculation

Fish species	Portion g
Cod, sey, ...*fresh or frozen*	125
Other marine fish *f ex plaice, maquerel,turbot?, sole*	125
Canned herring *pickled, anchovies etc*	50
Other canned fish *f ex tuna, sardine, maquerel*	75
Fiskpinnar, köpta Fish fingers, readymade	125
Fish balls, minced fish, fish gratin, readymade	150
Baltic herring	125
Smoked Baltic herring	90
Smoked West coast herring	90
Pacific salmon (e.g. Pink s.)	125
Baltic salmon and trout (not farmed)	125
Other salmonid fish species, rainbow trout, trout, char, whitefish	125
Pike, pike-perch, perch, burbot	125
Eel, boiled, fried, smoked	100
Caviar, roe	10
Liver from cod or burbot	50
Shellfish	90

Table A18b: List of fish species included in the fish groups used in intake calculations

Fish groups	Fish species included
Fatty Baltic fish	Baltic herring (incl. smoked), Baltic salmon, eel
Other fatty fish	Herring (incl. canned), other salmonid fishes (farmed salmon, trout, char, whitefish, other canned fish (maquerel, tuna, sardine), caviar, fish liver
Other fish	Cod plaice, pike, fish dishes, etc.

Dioxin intake in children, Sweden

(* = g/d values approximate; veg. fats and other fats given in g fat/d, other products in d whole product/d)

Dioxin intake from food in children of 4 (N=260), 8-9 (N=398) and 11-12 (N=465) years old is given in the adjacent table. Note that the overall intake of dioxins + DL-PCBs, when expressed on body weight basis, is decreasing with increasing age. The differences in intake between boys and girls are small. The study was performed during 2003.

Table A19: Dioxin intake from food in children

Country: Sweden, TEQ intake in children										
		pg WHO-TEQ/kg body wt/day (dioxins + PCBs)								
Food	**g/d***	**4 yr**			**8-9 yr**			**11-12 yr**		
		mean	**medi-an**	**95% perc.**	**mean**	**median**	**95% perc.**	**mean**	**me-dian**	**95% perc.**
Fish		1.0	0.67	2.9	0.91	0.54	2.9	0.65	0.37	2.0
Meat		0.64	0.57	1.2	0.53	0.48	1.0	0.36	0.26	0.71
Dairy products		0.60	0.52	1.3	0.40	0.35	0.92	0.26	0.21	0.65
Vegetable oils		0.28	0.24	0.65	0.16	0.13	0.39	0.09	0.07	0.25
Other fats		0.11	0.08	0.34	0.12	0.09	0.34	0.10	0.07	0.33
Eggs		0.02	0	0.10	0.01	0	0.06	0.01	0	0.04
Other		-	-	-	-	-	-	-	-	-
Sum all		2.6	2.4	4.8	2.2	1.8	4.2	1.5	1.2	3.0

Serum and breast milk

The levels of total-TEQ (DD/DF + DL-PCB; in pg/g fat) and of PCB_6 (CB 28, CB 52, CB 101, CB 138, CB 153, CB 180; in ng/g fat) in serum and breast milk from primiparous women living in the Uppsala region is given in the below table. Note that serum was analysed only for PCBs in women sampled 1996-99, and that the PCB levels in breast milk are based on four congeners (CB 28, CB 138, CB 153, CB 180), because of low levels for the remaining two congeners.

Table A20: levels of dioxins and PCBs in serum and breast milk

Sample description	analyte	N	mean	Min	median	max
Serum 1996-99	PCB_6	323	147	30	133	525
Breast milk 1996-99	PCB_4	203	133	44	125	365
Breast milk 2004	PCB_4	31	79	26	74	142
- " -	Total-TEQ	15	12	6.5	12	19

References

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Appendix II: Quality demands

The individual pork samples presented in Figure A1 and Table A21 illustrate that if the levels of dioxins and dioxin-like PCBs are low in a food sample, a low amount of starting material and/or low fat content will require very high analysing quality in order to achieve results that do not have too large difference between lower- and upper bound levels. The upper bound level in meat sample 1 is above the maximum level of 1.5 pg TEQ/g fat in pork, but it probably represents the sum of relatively high limits of quantification. In samples with high fat content, there is generally a smaller difference between upper- and lower bound levels than in those with lower fat content. However, it can be extracted from Figure A1 that this difference is not strictly connected to the fat content in the sample.

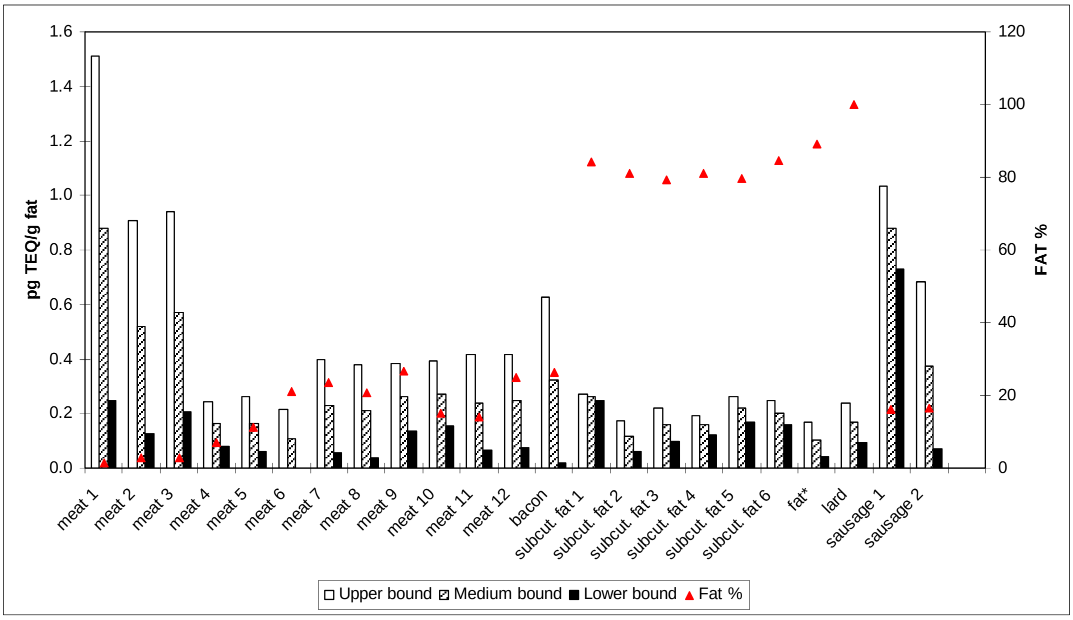

Figure A1: Relationship between upper bound, medium bound and lower bound levels of TEQ dioxins and dioxin-like PCBs and fat levels in individual analyses of pork samples. ****non-ortho PCB is missing in the sample.***

In Commission Regulation 2002/69, Annex II.6 states: “The difference between upperbound level and lower bound level shall not exceed 20 % for foodstuffs with a dioxin contamination of about 1 pg WHO-TEQ/g fat (based on the sum of PCDD/PCDF and dioxin-like PCBs). For foodstuffs with a low fat content, the same requirements for contamination levels of about 1 pg WHOTEQ/g product have to be applied. For lower contamination levels, for example 0,50 pg WHO-TEQ/g product,the difference between upperbound and lowerbound level may be in the range of 25 % to 40 %”.

The quality demand to analysis is very high, and in samples with low contamination level the difference between UB and LB determination may be more than 40%. National exposure calculations are often based on few samples, and including data that may be of poorer analysing quality may often be better than having no data, provided that both LB MB and UB exposures are calculated.

The concentrations of dioxins and DL-PCBs in the samples from pigs are generally lower than 0.5 pg TEQ (UB)/g fat (Table A21), and the differences between UB and LB levels are more than 40% for dioxins and DL-PCBs in all but five of the samples. This illustrates the very high demand to analyzing quality in samples with a low content of dioxins. It is not clear from Regulation 2002/69 whether the difference between UB and LB levels should be calculated relative to UB and LB levels. As we suppose that differences between UB and LB levels should be calculated relative to UB levels, this is presented in Table A21.

Table A21: Difference between upper bound (UB) and lower bound (LB) levels of dioxins, DL-PCBs and the sum of dioxins and DL-PCBs in the samples from pigs shown in Figure A1. Calculations are shown relative to UB levels (as % of UB).

FOOD	Fat content (%)	Dioxins (UB pg TEQ/g fat)	dlPCBs (UB) pg TEQ/g fat	dioxins +dlPCBs (UB) pg TEQ/g fat	% difference between UB and LB dioxins	% difference between UB and LB DL-PCBs	% difference between UB and LB dioxins + DL-PCBs
meat 1	1.5	0.30	1.21	1.51	93	81	84
meat 2	2.8	0.29	0.62	0.91	78	90	86
meat 3	2.9	0.31	0.63	0.94	63	85	78
meat 4	7.2	0.18	0.07	0.25	78	41	68
meat 5	11.3	0.20	0.06	0.26	86	45	77
meat 6	20.9	0.20	0.01	0.21	100	90	99
meat 7	23.6	0.36	0.04	0.40	91	36	86
meat 8	20.6	0.35	0.03	0.38	94	52	90
meat 9	26.7	0.35	0.04	0.38	65	65	65
meat 10	15.0	0.36	0.04	0.39	63	39	61
meat 11	14.1	0.38	0.03	0.41	86	65	84
meat 12	24.9	0.36	0.06	0.42	91	23	82
bacon	26.3	0.58	0.05	0.63	100	59	97
subcut. fat 1	84.3	0.20	0.07	0.27	10	0	7
subcut. fat 2	81.2	0.15	0.02	0.17	74	0	65
subcut. fat 3	79.3	0.17	0.05	0.22	70	2	55
subcut. fat 4	81.1	0.13	0.06	0.19	54	0	37
subcut. fat 5	79.6	0.12	0.14	0.26	75	0	35
subcut. fat 6	84.6	0.13	0.12	0.25	69	0	36
fat*	89.0	0.11	0.06	0.17	96	37	75
lard	100.0	0.20	0.04	0.24	74	3	62
sausage 1	16.3	0.51	0.52	1.03	56	3	29
sausage 2	16.4	0.60	0.09	0.68	99	26	90

*non-ortho PCB is missing in the sample.

Appendix III: Occurrence data

Ruminants

					Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound
					(WHO-TEQ) pg/g fat			(WHO-TEQ) pg/g fat			(WHO-TEQ) pg/g fat		
Country	**Year**	**Fat content**	**Food category (Ruminants, Poultry and farmed game, Pigs)**	**FOOD**	**DIOXIN + FURANS**	**DIOXIN + FURANS**	**DIOXIN + FURANS**	**DIOXIN – LIKE PCB**	**DIOXIN – LIKE PCB**	**DIOXIN-LIKE PCB**	**TOTAL**	**TOTAL**	**TOTAL**
Finland	2003	12,0	Ruminants	sheep meat	0,356	0,233	0,110	0,114	0,113	0,112	0,469	0,346	0,223
Finland	2003	15,0	Ruminants	sheep meat	0,100	0,052	0,004	0,138	0,138	0,138	0,239	0,190	0,142
Finland	2003	12,0	Ruminants	sheep meat	0,248	0,193	0,137	0,315	0,315	0,315	0,563	0,508	0,452
Finland	2004	9,4	Ruminants	bovine meat	0,237	0,145	0,052	0,196	0,195	0,195	0,433	0,340	0,2471
Finland	2004	14,0	Ruminants	bovine meat	0,229	0,121	0,014	0,130	0,130	0,129	0,359	0,251	0,143
Finland	2004	9,7	Ruminants	bovine meat	0,273	0,137	0,000	0,083	0,082	0,082	0,356	0,219	0,082
Finland	1998	22,0	Ruminants	bovine meat	0,590	0,512	0,434	0,467	0,467	0,466	1,057	0,979	0,900
Finland	1998	23,0	Ruminants	bovine meat	0,488	0,410	0,332	0,343	0,342	0,341	0,831	0,752	0,673
Finland	1998	21,0	Ruminants	bovine meat	0,837	0,764	0,691	0,193	0,186	0,180	1,030	0,951	0,871
Finland	1998	21,9	Ruminants	bovine meat	0,353	0,190	0,027	0,160	0,154	0,148	0,514	0,345	0,176
Finland	1998	26,7	Ruminants	bovine meat	0,384	0,281	0,177	0,233	0,227	0,221	0,618	0,508	0,399
Finland	2003	2,7	elk meat		0,385	0,206	0,027	0,919	0,919	0,919	1,304	1,125	0,946
Finland	2003	2,0	elk meat		0,352	0,186	0,020	1,083	1,083	1,083	1,436	1,270	1,104
Finland	2003	5,3	elk meat		0,286	0,146	0,006	0,591	0,590	0,590	0,877	0,736	0,596
Iceland	2003		Lamb	meat	0,280			0,330			0,610		
Iceland	2003		Lamb	*chuck*	0,150			0,032			0,182		
Iceland	2004		beef	muscle	0,200			0,340			0,540		
Iceland	2003		beef	*muscle*	0,220			0,500			0,720		
Iceland	2003		Ruminant	muscle	0,130			0,330			0,460		
Norway	2002	32	Ruminants	sheep muscle	0,170	0,087	0,005	0,172	0,153	0,135	0,342	0,241	0,139
Norway	2002	23	Ruminants	sheep muscle	0,255	0,223	0,191	0,282	0,256	0,230	0,537	0,479	0,421
Norway	2002	20	Ruminants	sheep muscle	0,225	0,170	0,115	0,273	0,243	0,213	0,498	0,413	0,328
Norway	2004	11,29	Ruminants	Fenalår, Ringstads (Sl	2,110	1,055	0,000	0,161	0,151	0,142	2,270	1,206	0,142
Norway	2004	7,4	Ruminants	Entrecòte, Gilde	2,265	1,916	1,567	1,104	1,104	1,104	3,369	3,020	2,671
Norway	2002	2,4	Ruminants	Cattle muscle	0,758	0,501	0,245	1,607	1,357	1,106	2,365	1,858	1,351
Norway	2002	1,3	Ruminants	Cattle muscle	0,895	0,448	0,000	1,898	1,332	0,765	2,793	1,779	0,766
Norway	2004	11,4	Ruminants	Kvernet kjøttdeig, Gil	1,939	0,985	0,032	0,296	0,282	0,269	2,235	1,268	0,301
Sweden	2004	70,66	Ruminants	Lamb, subcut. fat	0,890	0,870	0,850	0,510	0,510	0,510	1,400	1,380	1,360
Sweden	2004	60,89	Ruminants	Lamb, subcut. fat	0,940	0,870	0,790	1,600	1,600	1,600	2,540	2,470	2,390
Sweden	2003	70,92	Ruminants	Lamb, subcut. fat	0,410	0,380	0,360	0,540	0,540	0,540	0,950	0,920	0,900
Sweden	2003	71,14	Ruminants	Lamb, subcut. fat	0,610	0,590	0,560	0,890	0,890	0,890	1,500	1,480	1,450
Sweden	2004	83,49	Ruminants	Bovine, subcut. fat	0,380	0,280	0,170	0,200	0,200	0,200	0,580	0,480	0,370
Sweden	2004	71,31	Ruminants	Bovine, subcut. fat	0,530	0,480	0,420	0,660	0,660	0,660	1,190	1,140	1,080
Sweden	2004	77,29	Ruminants	Bovine, subcut. fat	0,760	0,710	0,660	1,300	1,300	1,300	2,060	2,010	1,960
Sweden	2003	82,98	Ruminants	Bovine, subcut. fat	0,270	0,180	0,090	0,460	0,460	0,460	0,730	0,640	0,550
Sweden	2003	45,68	Ruminants	Bovine, subcut. fat	0,600	0,430	0,260	2,080	2,080	2,080	2,680	2,510	2,340
Sweden	2003	59,89	Ruminants	Bovine, subcut. fat	0,500	0,380	0,250	1,560	1,560	1,560	2,060	1,940	1,810

Denmark	Number of samples	Minimum	Mean	Median	90% fractile	Maximum
Sheep fat	30	0,30	1,29	1,22	2,06	2,29
Beef fat	35	0,38	1,10	0,71	1,97	3,91

Poultry

					Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound	
					(WHO-TEQ) pg/g fat			(WHO-TEQ) pg/g fat			(WHO-TEQ) pg/g fat			
Country	**Year**	**Fat content**	**Food category (Ruminants, Poultry and farmed game, Pigs)**	**FOOD**	**DIOXIN + FURANS**	**DIOXIN + FURANS**	**DIOXIN + FURANS**	**DIOXIN – LIKE PCB**	**DIOXIN – LIKE PCB**	**DIOXIN-LIKE PCB**	**TOTAL**	**TOTAL**	**TOTAL**	
Finland	2004	8.6	Poultry	chicken meat	0.327	0.262	0.197	0.614	0.614	0.614	0.941	0.876	0.811	
Finland	2004	4.2	Poultry	chicken meat	0.347	0.300	0.253	0.392	0.392	0.392	0.739	0.692	0.645	
Finland	2004	6.9	Poultry	chicken meat	0.232	0.182	0.132	0.388	0.388	0.388	0.620	0.570	0.520	
Finland	2003	1.3	Poultry	chicken meat	0.703	0.374	0.044	0.079	0.064	0.050	0.782	0.438	0.094	
Finland	2004	4.0	Poultry	chicken meat	0.178	0.099	0.020	0.093	0.092	0.000	0.272	0.192	0.020	
Finland	2004	1.3	Poultry	chicken meat	0.528	0.365	0.202	0.869	0.868	0.867	1.397	1.233	1.069	
Finland	2003	1.3	Poultry	broiler meat	0.704	0.373	0.043	0.035	0.018	0.002	0.739	0.392	0.045	
Finland	2003	1.4	Poultry	broiler meat	0.631	0.474	0.317	0.142	0.136	0.134	0.773	0.610	0.451	
Finland	2003	1.3	Poultry	broiler meat	0.396	0.198	0.000	0.070	0.053	0.036	0.466	0.251	0.036	
Norway	2003	1.7	poultry	chicken muscle	0.826	0.613	0.401	2.755	1.418	0.082	3.580	2.032	0.483	no-PCB miss
Norway	2003	5.7	poultry	chicken muscle	0.339	0.294	0.249	0.658	0.354	0.049	0.998	0.648	0.298	no-PCB miss
Norway	2003	2.5	poultry	chicken muscle	0.543	0.413	0.282	1.989	0.994	0.000	2.532	1.407	0.282	no-PCB miss
Sweden	2004	77.74	Poultry	Chicken, subcut. fat	0.350	0.260	0.160	0.180	0.180	0.180	0.530	0.440	0.340	
Sweden	2004	82.82	Poultry	Chicken, subcut. Fat	0.600	0.560	0.510	0.490	0.490	0.490	1.090	1.050	1.000	
Sweden	2004	69.32	Poultry	Chicken, subcut. fat	0.380	0.330	0.280	0.210	0.210	0.200	0.590	0.540	0.480	
Sweden	2004	73.97	Poultry	Chicken, subcut. Fat	0.370	0.310	0.250	0.200	0.200	0.200	0.570	0.510	0.450	
Sweden	2004	70.1	Poultry	Chicken, subcut. Fat	0.380	0.320	0.250	0.130	0.130	0.130	0.510	0.450	0.380	
Sweden	2004	80.2	Poultry	Chicken, subcut. Fat	0.550	0.510	0.470	0.430	0.430	0.430	0.980	0.940	0.900	

Denmark 2000-2004		**TEQ dioxin (PCDD & PCDF) pg WHO-TEQ upper bound/g***					**TEQ PCB (mono and ortho PCB) pg WHO-TEQ upper bound/g***					**TEQ total (dioxin & PCB)pg WH**		
Foodstuff	**n**	**Minimum**	**Mean**	**Median**	**90% fractile**	**Maximum**	**Minimum**	**Mean**	**Median**	**90% fractile**	**Maximum**	**Minimum**	**Mean**	**Median**
Hen fat	4	0.12	0.36	0.19		0.94	0.09	0.47	0.14		1.49	0.21	0.83	0.33
Turkey fat	5	0.10	0.36	0.21		0.83	0.03	0.40	0.22		1.24	0.24	0.76	0.31
Chicken fat	61											0.12	0.50	0.33

Farmed game

					Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound
					(WHO-TEQ) pg/g fat			(WHO-TEQ) pg/g fat			(WHO-TEQ) pg/g fat		
Country	**Year**	**Fat content**	**Food category (Ruminants, Poultry and farmed game, Pigs)**	**FOOD**	**DIOXIN + FURANS**	**DIOXIN + FURANS**	**DIOXIN + FURANS**	**DIOXIN – LIKE PCB**	**DIOXIN – LIKE PCB**	**DIOXIN-LIKE PCB**	**TOTAL**	**TOTAL**	**TOTAL**
Finland	2003	4.0		reindeer meat	0.504	0.437	0.371	1.414	1.414	1.414	1.918	1.851	1.784
Finland	2003	8.4		reindeer meat	0.528	0.457	0.386	1.440	1.440	1.440	1.968	1.897	1.826
Finland	2003	3.3		reindeer meat	2.793	2.769	2.745	6.648	6.648	6.648	9.442	9.417	9.393
Norway	2002	2.8	Farmed game	reindeer meat	1.170	1.073	0.976	2.781	2.566	2.351	3.951	3.639	3.327
Norway	2002	2.2	Farmed game	reindeer meat	0.724	0.717	0.710	1.907	1.600	1.292	2.631	2.317	2.003
Norway	2002	3.5	Farmed game	reindeer meat	0.582	0.580	0.578	1.576	1.404	1.232	2.157	1.984	1.810
Norway	2002	1.2	Farmed game	reindeer meat	15.488	15.479	15.470	18.367	17.866	17.365	33.855	33.345	32.835
Norway	2002	2	Farmed game	reindeer meat	4.924	4.908	4.891	5.457	5.387	5.317	10.381	10.295	10.208
Sweden	1998			deer		3.600							

Pigs

					Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound		
					(WHO-TEQ) pg/g fat			(WHO-TEQ) pg/g fat			(WHO-TEQ) pg/g fat				
Country	**Year**	**Fat content**	**Food category (Ruminants, Poultry and farmed game, Pigs)**	**FOOD**	**DIOXIN + FURANS**	**DIOXIN + FURANS**	**DIOXIN+ FURANS**	**DIOXIN – LIKE PCB**	**DIOXIN – LIKE PCB**	**DIOXIN- LIKE PCB**	Upper Bound	Medium Bound	Lower Bound	**Fat content**	
Finland	2004	7,2	Pigs	meat	0,179	0,109	0,039	0,067	0,053	0,040	0,246	0,162	0,079	7,2	
Finland	2004	11,3	Pigs	meat	0,204	0,116	0,028	0,059	0,046	0,033	0,264	0,162	0,060	11,3	
Finland	2004	20,9	Pigs	meat	0,204	0,103	0,001	0,010	0,005	0,001	0,214	0,107	0,002	20,9	
Finland	1998	23,6	Pigs	meat	0,359	0,196	0,033	0,039	0,032	0,025	0,397	0,227	0,057	23,6	
Finland	1998	20,6	Pigs	meat	0,346	0,183	0,020	0,035	0,026	0,017	0,381	0,209	0,037	20,6	
Finland	1998	26,7	Pigs	meat	0,350	0,236	0,123	0,035	0,024	0,012	0,385	0,260	0,135	26,7	
Finland	1998	15,0	Pigs	meat	0,357	0,244	0,131	0,036	0,029	0,022	0,393	0,273	0,153	15,0	
Finland	1998	14,1	Pigs	meat	0,381	0,218	0,055	0,034	0,023	0,012	0,414	0,240	0,066	14,1	
Finland	1998	24,9	Pigs	meat	0,358	0,195	0,031	0,057	0,051	0,044	0,416	0,246	0,076	24,9	
Iceland	2003		Pig,Horgarbyggd	muscle	0,290			0,310			0,600				
Iceland	2003		Pig, minni vatnleysa	muscle	0,160			0,220			0,380				
Iceland	2004		Pig,Eyjafjordur	muscle	0,110			0,150			0,260				
Iceland	2004		Pig,Vatnleysa	muscle	0,180			0,670			0,850				
Norway	2002	1,5	pigs	meat	0,301	0,161	0,020	1,209	0,718	0,227	1,510	0,878	0,247	1,5	
Norway	2002	2,8	pigs	meat	0,286	0,174	0,062	0,624	0,345	0,065	0,910	0,519	0,128	2,8	
Norway	2002	2,9	pigs	meat	0,306	0,210	0,113	0,633	0,363	0,094	0,939	0,573	0,207	2,9	
Norway	2004	26,3	pigs	bacon	0,580	0,290	0,000	0,048	0,034	0,020	0,629	0,324	0,020	26,3	
Norway	2003	89	fat pigs	fat	0,106	0,055	0,004	0,060	0,049	0,038	0,166	0,104	0,042	89	no-PCB missing
Norway	2004	16,3		sausage 1	0,509	0,366	0,222	0,524	0,516	0,507	1,034	0,882	0,729	16,3	
Norway	2004	16,44		sausage 2	0,596	0,301	0,005	0,086	0,074	0,063	0,682	0,375	0,069	16,44	
Sweden	2004	84,34	Pigs	subcut.	0,200	0,190	0,180	0,070	0,070	0,070	0,270	0,260	0,250	84,34	
Sweden	2004	81,16	Pigs	subcut.	0,150	0,095	0,039	0,022	0,022	0,022	0,172	0,117	0,061	81,16	
Sweden	2004	79,33	Pigs	subcut.	0,170	0,110	0,051	0,050	0,050	0,049	0,220	0,160	0,100	79,33	
Sweden	2003	81,11	Pigs	subcut.	0,130	0,100	0,060	0,060	0,060	0,060	0,190	0,160	0,120	81,11	
Sweden	2003	79,55	Pigs	subcut.	0,120	0,080	0,030	0,140	0,140	0,140	0,260	0,220	0,170	79,55	
Sweden	2003	84,6	Pigs	subcut. Fat	0,130	0,080	0,040	0,120	0,120	0,120	0,250	0,200	0,160	84,6	
Sweden	2004	100	Fat pigs	lard	0,200	0,130	0,053	0,040	0,040	0,039	0,240	0,170	0,092	100	

Country:Denmark

Foodstuff	Number of samples	Minimum	Mean	Median	90% fractile	Maximum
Pork fat	35	0,14	0,28	0,25	0,34	1,01

Liver

					Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound	
					(WHO-TEQ) pg/g fat			(WHO-TEQ) pg/g fat			(WHO-TEQ) pg/g fat			
Country	**Year**	**Fat content**	**Food category (Liver, liver products)**	**FOOD**	**DIOXIN + FURANS**	**DIOXIN + FURANS**	**DIOXIN+ FURANS**	**DIOXIN – LIKE PCB**	**DIOXIN – LIKE PCB**	**DIOXIN- LIKE PCB**	**TOTAL**	**TOTAL**	**TOTAL**	
Finland	2003	3,7	Liver	pig liver	0,731	0,679	0,627	0,154	0,151	0,149	0,885	0,830	0,775	
Finland	2003	2,9	Liver	pig liver	0,933	0,769	0,605	0,152	0,150	0,148	1,085	0,919	0,753	
Finland	2003	3,0	Liver	bovine liver	0,193	0,122	0,051	0,334	0,332	0,330	0,527	0,454	0,381	
Finland	2003	3,3	Liver	bovine liver	1,344	1,277	1,211	0,492	0,491	0,489	1,836	1,768	1,700	
Finland	2003	4,1	Liver	bovine liver	0,090	0,054	0,017	0,289	0,286	0,284	0,379	0,340	0,301	
Iceland	2003		Lamb	lamb liver	0,830			0,940			1,770			
Iceland	2004		Lamb	lamb liver	1,310			1,130			2,440			
Norway	2002	2,6	Liver	Bovine liver	0,739	0,707	0,676	1,246	0,841	0,436	1,985	1,548	1,111	
Norway	2002	3,4	Liver	pig liver	8,211	7,486	6,761	0,614	0,330	0,047	8,824	7,816	6,808	no-PCB missing
Norway	2002	6,1	Liver	Sheep liver	6,487	6,484	6,481	0,381	0,248	0,115	6,868	6,732	6,596	no-PCB missing
Norway	2004	22,6	Liver products	Liverpate	0,830	0,560	0,290	0,278	0,278	0,278	1,108	0,838	0,568	
Norway	2004	16,55	Liver products	Liverpate	1,192	0,858	0,524	0,331	0,323	0,315	1,523	1,181	0,839	
Sweden	2003	3,88	Liver	Bovine, live	1,130	1,080	1,030	0,920	0,910	0,910	2,050	1,990	1,940	
Sweden	2003	4,42	Liver	Bovine, live	2,000	1,960	1,930	3,110	3,110	3,110	5,110	5,070	5,040	

Marine fish (not baltic)

					Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound
					(WHO-TEQ) pg/g fresh weight			(WHO-TEQ) pg/g fresh weight			(WHO-TEQ) pg/g fresh weight		
Country	Year	Fat content	Food category (Muscle meat fish w/ skin, muscle meat of fish w/o skin, fishery products)	FOOD	DIOXIN + FURANS	DIOXIN + FURANS	DIOXIN+ FURANS	DIOXIN – LIKE PCB	DIOXIN – LIKE PCB	DIOXIN- LIKE PCB	TOTAL	TOTAL	TOTAL
Iceland	2003	*	Salted cod	Cod	0.006	0.008	0.009	0.04	0.04	0.06	0.04	0.05	0.06
Iceland	2003	*	Cod, NE off Iceland	Cod	0.010	0.011	0.011	0.04	0.05	0.07	0.05	0.06	0.08
Iceland	2003		Cod, SW off Iceland	Cod	0.010	0.013	0.016	0.08	0.10	0.12	0.09	0.11	0.14
Iceland	2003	*	Haddock, SW off Icela	Haddock	0.007	0.009	0.011	0.02	0.04	0.05	0.03	0.05	0.06
Iceland	2003	**	Haddock, NE off Icela	Haddock	0.011	0.012	0.014	0.02	0.03	0.04	0.03	0.04	0.06
Iceland	2003		Pollock	Pollock	0.011	0.012	0.013	0.06	0.07	0.08	0.08	0.09	0.09
Iceland	2003		Catfish	Catfish		0.176			0.18			0.23	
Iceland	2003		Redfish	Redfish	0.031	0.061	0.086	0.28	0.33	0.37	0.36	0.39	0.41
Iceland	2003		Deepwater redfish	Deepwater redfish	0.118	0.202	0.314	0.30	0.48	0.75	0.42	0.68	1.06
Iceland	2003		Greenland halibut	Greenland halibut	0.332	0.439	0.522	0.63	0.96	1.21	0.96	1.40	1.68
Norway	2003	6.2	Muscle meat w/o skin	Halibut	1.411	1.410	1.410	3.222	3.222	3.222	4.633	4.632	4.632
Norway	2003	2.9	Muscle meat w/o skin	Halibut	0.276	0.276	0.276	0.433	0.433	0.433	0.709	0.709	0.709
Norway	2003	31.1	Muscle meat w/o skin	Halibut	7.571	7.570	7.568	11.665	11.665	11.665	19.236	19.235	19.234
Norway	2003	8.21	Muscle meat w/o skin	Herring	1.001	1.000	0.999	1.009	1.009	1.009	2.010	2.009	2.008
Norway	2003	6.65	Muscle meat w/o skin	Herring	0.851	0.850	0.850	0.857	0.857	0.857	1.708	1.707	1.707
Norway	2003	15.2	Muscle meat w/o skin	Herring	0.746	0.746	0.746	0.746	0.746	0.746	1.492	1.492	1.491
Norway	2003	14.22	Muscle meat w/o skin	Herring	0.527	0.527	0.527	0.525	0.525	0.525	1.052	1.052	1.051
Norway	2004	15.63	Muscle meat w/o skin	Herring	0.596	0.591	0.585	0.439	0.439	0.439	1.035	1.030	1.024
Norway	2004	12.25	Muscle meat w/o skin	Herring	0.770	0.760	0.760	0.660	0.660	0.660	1.430	1.420	1.420
Norway	2004	10.51	Muscle meat w/o skin	Herring	0.730	0.730	0.730	0.660	0.660	0.660	1.390	1.390	1.390
Norway	2004	13.29	Muscle meat w/o skin	Herring	0.680	0.670	0.670	0.550	0.550	0.550	1.230	1.220	1.220
Norway	2004	13.79	Muscle meat w/o skin	Herring	0.800	0.800	0.800	0.670	0.670	0.670	1.470	1.470	1.470
Norway	2004	13.88	Muscle meat w/o skin	Herring	0.500	0.500	0.500	0.460	0.460	0.460	0.960	0.960	0.960
Norway	2004	10.98	Muscle meat w/o skin	Herring	0.510	0.510	0.510	0.410	0.410	0.410	0.920	0.920	0.920
Norway	2004	13.3	Muscle meat w/o skin	Herring	0.690	0.690	0.690	0.560	0.560	0.560	1.250	1.250	1.250
Norway	2004	12.45	Muscle meat w/o skin	Herring	0.840	0.840	0.840	0.700	0.700	0.700	1.540	1.540	1.540
Norway	2004	12.46	Muscle meat w/o skin	Herring	0.570	0.570	0.570	0.540	0.540	0.540	1.110	1.110	1.110
Norway	2004	12.31	Muscle meat w/o skin	Herring	0.680	0.670	0.670	0.530	0.530	0.530	1.210	1.200	1.200
Norway	2004	9.65	Muscle meat w/o skin	Herring	0.630	0.630	0.630	0.520	0.520	0.520	1.150	1.150	1.150
Norway	2004	22.07	Muscle meat w/o skin	Mackerel	0.155	0.150	0.145	0.542	0.542	0.542	0.697	0.692	0.687
Norway	2004	22.8	Muscle meat w/o skin	Mackerel	0.130	0.130	0.120	0.430	0.430	0.430	0.560	0.560	0.550
Norway	2004	24.9	Muscle meat w/o skin	Mackerel	0.120	0.110	0.110	0.210	0.210	0.210	0.330	0.320	0.320
Norway	2004	22	Muscle meat w/o skin	Mackerel	0.100	0.100	0.090	0.390	0.390	0.390	0.490	0.490	0.480
Norway	2004	20.4	Muscle meat w/o skin	Mackerel	0.290	0.290	0.290	0.720	0.720	0.720	1.010	1.010	1.010
Norway	2004	23.1	Muscle meat w/o skin	Mackerel	0.200	0.190	0.190	0.500	0.500	0.500	0.700	0.690	0.690
Norway	2004	22.8	Muscle meat w/o skin	Mackerel	0.110	0.100	0.090	0.540	0.540	0.540	0.650	0.640	0.630
Norway	2004	14.9	Muscle meat w/o skin	Mackerel	0.220	0.210	0.200	0.620	0.620	0.620	0.840	0.830	0.820
Norway	2004	22	Muscle meat w/o skin	Mackerel	0.220	0.220	0.210	0.470	0.470	0.470	0.690	0.690	0.680
Norway	2004	25.3	Muscle meat w/o skin	Mackerel	0.140	0.130	0.120	0.330	0.330	0.330	0.470	0.460	0.450
Norway	2004	27	Muscle meat w/o skin	Mackerel	0.140	0.130	0.120	0.360	0.360	0.360	0.500	0.490	0.480
Norway	2004	22.7	Muscle meat w/o skin	Mackerel	0.140	0.130	0.130	0.210	0.210	0.210	0.350	0.340	0.340
Norway	2003	28.61	Muscle meat w/o skin	Mackerel	0.204	0.197	0.191	0.624	0.624	0.624	0.828	0.821	0.814
Norway	2003	27.54	Muscle meat w/o skin	Mackerel	0.134	0.130	0.126	0.541	0.541	0.541	0.676	0.671	0.667
Norway	2004	0.93	Muscle meat w/o skin	Cod	0.028	0.027	0.026	0.011	0.011	0.011	0.039	0.038	0.037
Norway	2004	0.94	Muscle meat w/o skin	Cod	0.007	0.004	0.002	0.015	0.015	0.015	0.021	0.019	0.016
Norway	2004	0.83	Muscle meat w/o skin	Cod	0.035	0.034	0.032	0.034	0.034	0.034	0.070	0.068	0.066
Norway	2004	0.96	Muscle meat w/o skin	Cod	0.026	0.025	0.023	0.023	0.023	0.023	0.049	0.047	0.045
Norway	2004	0.82	Muscle meat w/o skin	Cod	0.022	0.021	0.019	0.035	0.035	0.035	0.057	0.056	0.054
Norway	2004		Muscle meat w/o skin	Haddock	0.021	0.019	0.017	0.029	0.029	0.029	0.050	0.048	0.046
Norway	2004	1.8	Muscle meat w/o skin	Redfish	0.118	0.115	0.112	0.138	0.138	0.138	0.256	0.253	0.249
Norway	2004	4.7	Muscle meat w/o skin	Redfish	0.330	0.320	0.310	0.400	0.400	0.400	0.730	0.720	0.710
Norway	2004	5.9	Muscle meat w/o skin	Redfish	0.270	0.270	0.270	0.440	0.440	0.440	0.710	0.710	0.710
Norway	2004	2.3	Muscle meat w/o skin	Redfish	0.200	0.200	0.190	0.310	0.310	0.310	0.510	0.510	0.500
Norway	2004	4.3	Muscle meat w/o skin	Redfish	0.400	0.400	0.400	2.270	2.270	2.270	2.670	2.670	2.670
Norway	2004	1.8	Muscle meat w/o skin	Redfish	0.070	0.060	0.060	0.170	0.170	0.170	0.240	0.230	0.230
Norway	2004	3.9	Muscle meat w/o skin	Redfish	0.210	0.210	0.200	0.260	0.260	0.260	0.470	0.470	0.460
Norway	2004	3.5	Muscle meat w/o skin	Redfish	0.260	0.260	0.260	0.770	0.770	0.770	1.030	1.030	1.030
Norway	2004	6	Muscle meat w/o skin	Redfish	0.350	0.350	0.350	0.360	0.360	0.360	0.710	0.710	0.710
Norway	2004	2.4	Muscle meat w/o skin	Redfish	0.200	0.200	0.190	0.240	0.240	0.240	0.440	0.440	0.430
Norway	2004	3.5	Muscle meat w/o skin	Redfish	0.360	0.360	0.360	0.570	0.570	0.570	0.930	0.930	0.930
Norway	2004	1.8	Muscle meat w/o skin	Redfish	0.120	0.110	0.110	0.300	0.300	0.300	0.420	0.410	0.410
Norway	2004	1.1	Muscle meat w/o skin	Saithe	0.040	0.030	0.030	0.120	0.120	0.120	0.160	0.150	0.150
Norway	2004	1.2	Muscle meat w/o skin	Saithe	0.020	0.010	0.010	0.130	0.130	0.130	0.150	0.140	0.140
Norway	2004	1.4	Muscle meat w/o skin	Saithe	0.030	0.030	0.030	0.090	0.090	0.090	0.120	0.120	0.120
Norway	2004	1.3	Muscle meat w/o skin	Saithe	0.040	0.030	0.030	0.280	0.280	0.280	0.320	0.310	0.310
Norway	2004	1.2	Muscle meat w/o skin	Saithe	0.020	0.010	0.010	0.080	0.080	0.080	0.100	0.090	0.090
Norway	2004	1.6	Muscle meat w/o skin	Saithe	0.020	0.020	0.010	0.070	0.070	0.070	0.090	0.090	0.080
Norway	2004	1.6	Muscle meat w/o skin	Saithe	0.030	0.030	0.030	0.180	0.180	0.180	0.210	0.210	0.210
Norway	2004	1.4	Muscle meat w/o skin	Saithe	0.020	0.010	0.010	0.100	0.100	0.100	0.120	0.110	0.110
Norway	2004	1.3	Muscle meat w/o skin	Saithe	0.030	0.030	0.030	0.230	0.230	0.230	0.260	0.260	0.260
Norway	2004	1.2	Muscle meat w/o skin	Saithe	0.020	0.020	0.010	0.110	0.110	0.110	0.130	0.130	0.120
Norway	2004	0.92	Muscle meat w/o skin	Cod	0.007	0.005	0.002	0.024	0.024	0.024	0.031	0.029	0.026

* Cod and Haddock have a fat content around 0,2-0,4%

** Greenland Halibut has a fat content around 10-11%

Denmark 2000-2004		TEQ dioxin (PCDD & PCDF) pg WHO-TEQ upper bound/g*					TEQ PCB (mono and ortho PCB) pg WHO-TEQ upper bound/g*					TEQ total (dioxin	
Foodstuff	**n**	**Minimum**	**Mean**	**Median**	**90% fractile**	**Maximum**	**Minimum**	**Mean**	**Median**	**90% fractile**	**Maximum**	**Minimum**	**Mean**
Herring - North Sea and Belts	16	0.36	1.11	1.05	1.79	2.89	0.31	1.21	1.10	1.72	4.70	0.68	2.32
Eel - The Sound	5	1.11	2.29	2.12		3.94	2.44	6.02	6.79		8.29	3.56	8.31
Eel - The Kattegat w. of Hirsholmen	5	0.65	0.89	0.93		1.19	1.83	2.43	2.31		2.94	2.48	3.33
Norway 2003		**TEQ dioxin (PCDD & PCDF) pg WHO-TEQ upper bound/g***					**TEQ PCB (mono and ortho PCB) pg WHO-TEQ upper bound/g***					**TEQ total (dioxin**	
	n	**Minimum**	**Mean**	**Median**	**90% fractile**	**Maximum**	**Minimum**	**Mean**	**Median**	**90% fractile**	**Maximum**	**Minimum**	**Mean**
Høvåg Vest-Agder	3											1.8	2.6
Vest-Agder*	3											1.9	4.3
Bjekheim Rogaland	6											0.97	1.80
Fusa Hordaland	6											1.10	1.40
Brandasund Hordaland	2											1.80	2.20
Uranvåg Hordaland	3											10.00	11.30
Alvøen Hordaland	3											1.90	3.90
Rydlandsvågen Hordaland	3											1.30	1.70
Larviksfjorden Vestfold	3											4.10	5.40

Wild freshwater fish

Country	Year	Fat content	Food category (Muscle meat fish w/ skin, muscle meat of fish w/o skin, fishery products)	FOOD	Upper Bound (WHO-TEQ) pg/g fresh weight DIOXIN + FURANS	Medium Bound DIOXIN + FURANS	Lower Bound DIOXIN+ FURANS	Upper Bound (WHO-TEQ) pg/g fresh weight DIOXIN – LIKE PCB	Medium Bound DIOXIN – LIKE PCB	Lower Bound DIOXIN- LIKE PCB	Upper Bound (WHO-TEQ) pg/g fresh TOTAL	Medium Bound TOTAL	Lower Bound TOTAL
Finland	2002	0,35	muscle meat w skin	IL Burbot, pool	0,533	0,532	0,532	0,307	0,307	0,307	0,839	0,839	0,839
Finland	2002	0,44	muscle meat w skin	IL Burbot, pool	0,167	0,166	0,166	0,298	0,298	0,298	0,465	0,464	0,464
Finland	2002	0,35	muscle meat w skin	IL Burbot, pool	0,0607	0,0597	0,0587	0,0509	0,0509	0,0509	0,112	0,111	0,110
Finland	2002	3,82	muscle meat w skin	IL Bream, pool	3,370	3,370	3,370	1,618	1,618	1,618	4,988	4,988	4,988
Finland	2002	3,17	muscle meat w skin	IL Bream, pool	4,583	4,583	4,583	2,661	2,661	2,661	7,244	7,244	7,244
Finland	2002	6,09	muscle meat w skin	IL Bream, pool	0,990	0,988	0,986	0,767	0,762	0,757	1,757	1,750	1,743
Finland	2002	7,54	muscle meat w skin	IL Bream, pool	1,680	1,678	1,675	1,464	1,464	1,464	3,144	3,142	3,139
Finland	2002	7,10	muscle meat w skin	IL Bream, pool	0,386	0,378	0,370	0,279	0,267	0,255	0,664	0,645	0,626
Finland	2002	9,05	muscle meat w skin	IL Bream, pool	1,051	1,047	1,042	0,833	0,818	0,804	1,884	1,865	1,846
Finland	2002	3,11	muscle meat w skin	IL Vendace, pool	1,288	1,287	1,286	0,849	0,849	0,849	2,137	2,136	2,135
Finland	2002	3,09	muscle meat w skin	IL Vendace, pool	1,438	1,437	1,436	1,027	1,027	1,027	2,465	2,464	2,463
Finland	2002	4,87	muscle meat w skin	IL Vendace, pool	2,304	2,303	2,302	1,779	1,779	1,779	4,083	4,082	4,081
Finland	2002	2,77	muscle meat w skin	IL Vendace, pool	0,417	0,417	0,416	0,584	0,584	0,584	1,001	1,001	1,000
Finland	2002	1,37	muscle meat w skin	IL Vendace, pool	0,747	0,746	0,746	1,221	1,221	1,221	1,968	1,967	1,967
Finland	2002	0,83	muscle meat w skin	IL Vendace, pool	0,756	0,756	0,755	1,299	1,299	1,299	2,055	2,055	2,054
Finland	2002	2,84	muscle meat w skin	IL Vendace, pool	0,390	0,390	0,389	0,372	0,372	0,372	0,762	0,762	0,761
Finland	2002	2,31	muscle meat w skin	IL Vendace, pool	0,364	0,364	0,364	0,399	0,399	0,399	0,763	0,763	0,763
Finland	2002	1,87	muscle meat w skin	IL Vendace, pool	0,391	0,391	0,391	0,403	0,403	0,403	0,794	0,794	0,794
Finland	2002	2,71	muscle meat w skin	IL Whitefish, pool	0,877	0,877	0,876	0,796	0,796	0,796	1,673	1,672	1,672
Finland	2002	4,32	muscle meat w skin	IL Whitefish, pool	2,625	2,624	2,623	2,067	2,067	2,067	4,692	4,691	4,690
Finland	2002	1,74	muscle meat w skin	IL Whitefish, pool	0,615	0,615	0,614	1,323	1,323	1,323	1,938	1,938	1,937
Finland	2002	2,20	muscle meat w skin	IL Whitefish, pool	0,552	0,552	0,551	1,206	1,206	1,206	1,758	1,758	1,757
Finland	2002	0,73	muscle meat w skin	IL Whitefish, pool	0,168	0,168	0,167	0,172	0,172	0,172	0,341	0,340	0,339
Finland	2002	0,85	muscle meat w skin	IL Whitefish, pool	0,164	0,163	0,163	0,199	0,199	0,199	0,363	0,362	0,362
Finland	2003	2,35	muscle meat w skin	IL Smelt, pool	0,434	0,431	0,428	0,376	0,376	0,376	0,810	0,808	0,805
Finland	2003	2,39	muscle meat w skin	IL Smelt, pool	0,606	0,603	0,600	0,628	0,628	0,628	1,234	1,231	1,228
Finland	2003	2,79	muscle meat w skin	IL Roach, pool	0,217	0,215	0,213	0,286	0,286	0,286	0,503	0,501	0,498
Finland	2003	15,43	muscle meat w skin	river River lamprey, pool	5,906	5,888	5,870	4,367	4,367	4,367	10,273	10,255	10,236
Finland	2003	18,35	muscle meat w skin	river River lamprey, pool	7,663	7,643	7,623	5,414	5,414	5,414	13,076	13,057	13,037
Finland	2003	21,36	muscle meat w skin	river River lamprey, pool	8,676	8,659	8,643	5,497	5,497	5,497	14,173	14,156	14,140
Finland	2002	0,87	muscle meat w skin	IL Pike-perch, pool	0,273	0,273	0,273	0,513	0,513	0,513	0,786	0,786	0,785
Finland	2002	0,78	muscle meat w skin	IL Pike-perch, pool	0,319	0,319	0,319	0,587	0,587	0,587	0,906	0,906	0,906
Finland	2002	1,80	muscle meat w skin	IL Pike-perch, pool	0,147	0,144	0,142	0,210	0,210	0,210	0,357	0,354	0,351
Finland	2002	3,31	muscle meat w skin	IL Pike-perch, pool	0,276	0,274	0,273	0,445	0,445	0,445	0,721	0,720	0,719
Finland	2002	0,68	muscle meat w skin	IL Perch, pool	0,219	0,218	0,218	0,303	0,303	0,303	0,521	0,521	0,521
Finland	2002	1,33	muscle meat w skin	IL Perch, pool	0,324	0,324	0,323	0,707	0,707	0,707	1,031	1,031	1,031
Finland	2002	1,13	muscle meat w skin	IL Perch, pool	0,324	0,324	0,324	0,727	0,727	0,727	1,051	1,051	1,051
Finland	2002	1,47	muscle meat w skin	IL Perch, pool	0,441	0,441	0,440	0,888	0,888	0,888	1,329	1,329	1,328
Finland	2002	0,96	muscle meat w skin	IL Perch, pool	0,116	0,115	0,114	0,155	0,155	0,155	0,271	0,270	0,269
Finland	2002	1,01	muscle meat w skin	IL Perch, pool	0,077	0,077	0,076	0,155	0,155	0,155	0,233	0,232	0,232
Finland	2002	0,23	muscle meat w skin	IL Pike, pool	0,202	0,201	0,200	0,260	0,260	0,260	0,462	0,461	0,460
Finland	2002	0,65	muscle meat w skin	IL Pike, pool	1,599	1,598	1,597	1,860	1,860	1,860	3,459	3,458	3,457
Finland	2002	0,15	muscle meat w skin	IL Pike, pool	0,070	0,069	0,068	0,108	0,108	0,108	0,178	0,177	0,177
Finland	2002	0,55	muscle meat w skin	IL Pike, pool	0,379	0,377	0,375	0,589	0,589	0,589	0,968	0,966	0,964
Finland	2002	0,40	muscle meat w skin	IL Pike, pool	0,140	0,137	0,134	0,225	0,225	0,225	0,366	0,363	0,360
Finland	2002	0,62	muscle meat w skin	IL Pike, pool	0,218	0,213	0,208	0,328	0,328	0,328	0,546	0,541	0,536
Iceland	2004		fishery products	Salmon	0,420			0,88					
Iceland	2004		fishery products	Salmon	0,430			0,96					
Iceland	2004		fishery products	Salmon	0,420			0,88			1,3		
Iceland	2004		fishery products	Salmon	0,430			0,96			1,4		
Iceland	2004		fishery products	Arctic charr (Kelduvikurvatn)	0,020			0,08			0,1		
Iceland	2004		fishery products	Arctic charr (thingvallavatn)	0,040			0,44			0,5		
Sweden	2002	6,11	muscle meat w/o skin	Salmon (L. Vänern)	1,500	1,500	1,500	2,300	2,300	2,200	3,800	3,800	3,700
Sweden	2002	6,92	muscle meat w/o skin	Salmon (L. Vänern)	1,800	1,800	1,700	2,700	2,700	2,600	4,500	4,500	4,300
Sweden	2003	6,04	muscle meat w/o skin	Salmon (L. Vänern)	2,600	2,600	2,600	3,300	3,300	3,200	5,900	5,900	5,800
Sweden	2003	8,02	muscle meat w/o skin	Salmon (L. Vänern)	4,000	4,000	4,000	5,100	5,000	5,000	9,100	9,000	9,000
Sweden	2002	9,44	muscle meat w/o skin	Salmon (L. Vättern)	2,000	2,000	2,000	6,100	6,000	6,000	8,100	8,000	8,000
Sweden	2002	10,5	muscle meat w/o skin	Salmon (L. Vättern)	3,100	3,100	3,100	9,400	9,400	9,400	12,500	12,500	12,500
Sweden	2003	4,28	muscle meat w/o skin	Salmon (L. Vättern)	3,000	3,000	3,000	9,200	9,200	9,200	12,200	12,200	12,200

Farmed fish													
					Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound
					(WHO-TEQ) pg/g fresh weight			(WHO-TEQ) pg/g fresh weight			(WHO-TEQ) pg/g fresh weight		
Country	**Year**	**Fat content**	**Food category (Muscle meat fish w/ skin, muscle meat of fish w/o skin, fishery products)**	**FOOD**	**DIOXIN + FURANS**	**DIOXIN + FURANS**	**DIOXIN+ FURANS**	**DIOXIN – LIKE PCB**	**DIOXIN – LIKE PCB**	**DIOXIN- LIKE PCB**	TOTAL	**TOTAL**	**TOTAL**
Finland	2004	19,6	muscle meat w skin	farmed Rainbow trout, pool	0,372	0,366	0,360	1,438	1,438	1,438	1,810	1,804	1,798
Finland	2004	14,2	muscle meat w skin	farmed Rainbow trout, pool	0,382	0,375	0,369	1,294	1,294	1,294	1,676	1,669	1,662
Finland	2004	21,3	muscle meat w skin	farmed Rainbow trout, pool	0,615	0,604	0,592	2,068	2,068	2,068	2,683	2,672	2,660
Finland	1999	13,26	muscle meat w skin	farmed Rainbow trout, pool	1,125	1,124	1,124	1,974	1,974	1,974	3,099	3,098	3,098
Finland	1999	6,13	muscle meat w skin	farmed Rainbow trout, pool	0,663	0,663	0,663	1,310	1,309	1,309	1,973	1,973	1,972
Finland	1999	6,18	muscle meat w skin	farmed Rainbow trout, pool	0,498	0,497	0,496	0,960	0,960	0,960	1,458	1,457	1,456
Finland	1999	6,91	muscle meat w skin	farmed Rainbow trout, pool	0,688	0,688	0,687	1,113	1,113	1,113	1,802	1,801	1,800
Finland	1999	5,52	muscle meat w skin	farmed Rainbow trout, pool	0,497	0,496	0,495	0,906	0,906	0,906	1,403	1,402	1,401
Finland	1999	9,15	muscle meat w skin	farmed Rainbow trout, pool	1,400	1,399	1,399	2,084	2,084	2,084	3,484	3,483	3,483
Finland	1999	10,33	muscle meat w skin	farmed Rainbow trout, pool	0,693	0,692	0,691	1,226	1,225	1,225	1,919	1,918	1,916
Finland	1999	9,02	muscle meat w skin	farmed Rainbow trout, pool	0,975	0,975	0,974	1,770	1,770	1,770	2,745	2,745	2,745
Finland	2002	5,98	muscle meat w skin	farmed Arctic char, pool	0,772	0,771	0,771	1,938	1,828	1,938	2,710	2,599	2,709
Finland	2002	22,43	muscle meat w skin	farmed Whitefish, pool	1,385	1,350	1,315	2,522	2,522	2,522	3,907	3,872	3,837
Iceland	2003		fishery products	salmon (farmed)	0,29			0,79			1,080		
Iceland	2004		fishery products	salmon (farmed)	0,310			0,69			1,000		
Iceland	2003		fishery products	Arctic charr(farmed)	0,260			0,82			1,080		
Iceland	2004		fishery products	Arctic charr(farmed)	0,150			0,56			0,710		
Norway	2003		Muscle meat w/o skin	salmon (farmed)	0,692	0,614	0,537	1,381	1,381	1,381	2,073	1,996	1,918
Norway	2003	4,1	Muscle meat w/o skin	salmon (farmed)	0,494	0,420	0,345	0,417	0,417	0,417	0,911	0,836	0,762
Norway	2003		Muscle meat w/o skin	salmon (farmed)	1,187	1,187	1,187	0,975	0,975	0,975	2,161	2,161	2,161
Norway	2003		Muscle meat w/o skin	salmon (farmed)	0,937	0,861	0,785	1,016	1,016	1,016	1,953	1,877	1,801
Norway	2003		Muscle meat w/o skin	salmon (farmed)	1,003	0,945	0,887	0,932	0,932	0,932	1,935	1,878	1,820
Norway	2003		Muscle meat w/o skin	salmon (farmed)	0,913	0,837	0,761	0,980	0,980	0,980	1,894	1,817	1,741
Norway	2003		Muscle meat w/o skin	salmon (farmed)	0,967	0,944	0,921	1,100	1,100	1,100	2,067	2,044	2,022
Norway	2003		Muscle meat w/o skin	salmon (farmed)	0,784	0,727	0,670	1,197	1,197	1,197	1,981	1,924	1,867
Norway	2003		Muscle meat w/o skin	salmon (farmed)	0,652	0,572	0,491	1,266	1,266	1,266	1,919	1,838	1,757
Norway	2003		Muscle meat w/o skin	salmon (farmed)	0,592	0,510	0,427	1,181	1,181	1,181	1,774	1,691	1,608
Norway	2003		Muscle meat w/o skin	salmon (farmed)	0,624	0,545	0,466	1,466	1,466	1,466	2,090	2,011	1,933
Norway	2003	17,3	Muscle meat w/o skin	salmon (farmed)	0,388	0,387	0,387	1,118	1,118	1,118	1,505	1,505	1,505
Norway	2003	14,6	Muscle meat w/o skin	salmon (farmed)	0,451	0,451	0,451	1,112	1,112	1,112	1,563	1,563	1,562
Norway	2003	17,2	Muscle meat w/o skin	salmon (farmed)	0,421	0,421	0,420	1,156	1,156	1,156	1,577	1,577	1,577
Norway	2003	16,1	Muscle meat w/o skin	salmon (farmed)	0,400	0,400	0,400	1,089	1,089	1,089	1,489	1,489	1,489
Norway	2003	17,9	Muscle meat w/o skin	salmon (farmed)	0,414	0,413	0,413	1,152	1,152	1,152	1,566	1,565	1,565
Norway	2003	13,2	Muscle meat w/o skin	salmon (farmed)	0,266	0,266	0,265	0,906	0,906	0,906	1,172	1,171	1,171
Norway	2003	18,6	Muscle meat w/o skin	salmon (farmed)	0,276	0,275	0,274	1,014	1,014	1,014	1,290	1,288	1,287
Norway	2003	14,2	Muscle meat w/o skin	salmon (farmed)	0,220	0,219	0,218	0,762	0,762	0,762	0,981	0,981	0,980
Norway	2003	14,4	Muscle meat w/o skin	salmon (farmed)	0,281	0,280	0,279	0,950	0,950	0,950	1,231	1,230	1,229
Norway	2003	11	Muscle meat w/o skin	salmon (farmed)	0,253	0,252	0,251	0,866	0,866	0,866	1,118	1,117	1,116
Norway	2003	10,4	Muscle meat w/o skin	salmon (farmed)	0,613	0,613	0,613	1,521	1,521	1,521	2,134	2,134	2,134
Norway	2003	9	Muscle meat w/o skin	salmon (farmed)	0,691	0,691	0,691	1,464	1,464	1,464	2,156	2,155	2,155
Norway	2003	13,6	Muscle meat w/o skin	salmon (farmed)	0,808	0,808	0,807	1,707	1,707	1,707	2,515	2,515	2,515
Norway	2003	12,5	Muscle meat w/o skin	salmon (farmed)	0,724	0,724	0,724	1,578	1,578	1,578	2,303	2,302	2,302
Norway	2003	14,2	Muscle meat w/o skin	salmon (farmed)	0,693	0,692	0,692	1,663	1,663	1,663	2,356	2,355	2,355
Norway	2003	13,2	Muscle meat w/o skin	salmon (farmed)	0,839	0,769	0,699	0,938	0,938	0,938	1,776	1,706	1,636
Norway	2003	12,5	Muscle meat w/o skin	salmon (farmed)	0,877	0,800	0,724	1,046	1,046	1,046	1,923	1,846	1,770
Norway	2003	14,8	Muscle meat w/o skin	salmon (farmed)	0,868	0,787	0,707	1,141	1,141	1,141	2,009	1,928	1,848
Norway	2003	15,8	Muscle meat w/o skin	salmon (farmed)	0,818	0,738	0,657	0,950	0,950	0,950	1,768	1,687	1,607
Norway	2003	15,5	Muscle meat w/o skin	salmon (farmed)	0,858	0,778	0,697	0,997	0,997	0,997	1,855	1,774	1,694
Norway	2003	16,3	Muscle meat w/o skin	salmon (farmed)	0,670	0,590	0,509	0,958	0,958	0,958	1,628	1,547	1,467
Norway	2003	15,1	Muscle meat w/o skin	salmon (farmed)	0,578	0,497	0,417	0,838	0,838	0,838	1,416	1,335	1,255
Norway	2003	14,3	Muscle meat w/o skin	salmon (farmed)	0,530	0,450	0,369	0,802	0,802	0,802	1,332	1,251	1,171
Norway	2003	13,9	Muscle meat w/o skin	salmon (farmed)	0,574	0,493	0,413	0,771	0,771	0,771	1,345	1,265	1,184
Norway	2003	13,3	Muscle meat w/o skin	salmon (farmed)	0,549	0,468	0,388	0,763	0,763	0,763	1,312	1,231	1,151
Norway	2004	16	Muscle meat w/o skin	salmon (farmed)	0,550	0,550	0,550	1,840	1,840	1,840	2,390	2,390	2,390
Norway	2004	15,7	Muscle meat w/o skin	salmon (farmed)	0,390	0,390	0,390	1,030	1,030	1,030	1,420	1,420	1,420
Norway	2004	7,9	Muscle meat w/o skin	salmon (farmed)	0,260	0,260	0,260	1,120	1,120	1,120	1,380	1,380	1,380
Norway	2004	11,4	Muscle meat w/o skin	salmon (farmed)	0,390	0,390	0,390	1,290	1,290	1,290	1,680	1,680	1,680
Norway	2004	14,5	Muscle meat w/o skin	salmon (farmed)	0,560	0,560	0,560	1,810	1,810	1,810	2,370	2,370	2,370
Norway	2004	13,9	Muscle meat w/o skin	salmon (farmed)	0,530	0,530	0,530	1,250	1,250	1,250	1,780	1,780	1,780
Norway	2004	15,8	Muscle meat w/o skin	salmon (farmed)	0,490	0,490	0,490	1,440	1,440	1,440	1,930	1,930	1,930
Norway	2004	14,8	Muscle meat w/o skin	salmon (farmed)	0,500	0,500	0,500	1,790	1,790	1,790	2,290	2,290	2,290
Norway	2004	14,5	Muscle meat w/o skin	salmon (farmed)	0,650	0,650	0,650	1,810	1,810	1,810	2,460	2,460	2,460
Norway	2004	8	Muscle meat w/o skin	salmon (farmed)	0,630	0,630	0,630	1,760	1,760	1,760	2,390	2,390	2,390
Norway	2004	8,2	Muscle meat w/o skin	salmon (farmed)	0,270	0,270	0,270	0,990	0,990	0,990	1,260	1,260	1,260
Norway	2004	9	Muscle meat w/o skin	salmon (farmed)	0,390	0,380	0,380	0,930	0,930	0,930	1,320	1,310	1,310
Norway	2004	7,6	Muscle meat w/o skin	salmon (farmed)	0,290	0,290	0,290	0,850	0,850	0,850	1,140	1,140	1,140
Norway	2004	15,1	Muscle meat w/o skin	salmon (farmed)	0,550	0,550	0,550	1,760	1,760	1,760	2,310	2,310	2,310
Norway	2004	8,4	Muscle meat w/o skin	salmon (farmed)	0,250	0,250	0,250	0,950	0,950	0,950	1,200	1,200	1,200
Norway	2004	5,1	Muscle meat w/o skin	salmon (farmed)	0,290	0,290	0,290	0,680	0,680	0,680	0,970	0,970	0,970
Norway	2004	4,7	Muscle meat w/o skin	salmon (farmed)	0,200	0,200	0,200	0,820	0,820	0,820	1,020	1,020	1,020
Norway	2004	10,7	Muscle meat w/o skin	salmon (farmed)	0,270	0,270	0,270	1,010	1,010	1,010	1,280	1,280	1,280
Norway	2004	8,5	Muscle meat w/o skin	salmon (farmed)	0,250	0,250	0,240	0,800	0,800	0,800	1,050	1,050	1,040
Norway	2004	12,7	Muscle meat w/o skin	salmon (farmed)	0,370	0,370	0,360	1,380	1,380	1,380	1,750	1,750	1,740
Norway	2004	9,8	Muscle meat w/o skin	salmon (farmed)	0,270	0,270	0,270	0,990	0,990	0,990	1,260	1,260	1,260
Norway	2004	15,7	Muscle meat w/o skin	salmon (farmed)	0,460	0,460	0,460	1,110	1,110	1,110	1,570	1,570	1,570
Norway	2004	15,5	Muscle meat w/o skin	salmon (farmed)	0,640	0,640	0,640	2,090	2,090	2,090	2,730	2,730	2,730
Norway	2004	10,9	Muscle meat w/o skin	salmon (farmed)	0,370	0,370	0,370	1,090	1,090	1,090	1,460	1,460	1,460
Norway	2004	12,6	Muscle meat w/o skin	salmon (farmed)	0,480	0,480	0,480	1,280	1,280	1,280	1,760	1,760	1,760
Norway	2004	15,5	Muscle meat w/o skin	salmon (farmed)	0,580	0,580	0,580	1,580	1,580	1,580	2,160	2,160	2,160
Norway	2004	9,7	Muscle meat w/o skin	salmon (farmed)	0,250	0,250	0,250	0,670	0,670	0,670	0,920	0,920	0,920
Norway	2004	13,3	Muscle meat w/o skin	salmon (farmed)	0,530	0,520	0,520	1,540	1,540	1,540	2,070	2,060	2,060
2000-2004													
TEQ total (dioxin & PCB)													
Denmark		Number of samples	Minimum	Mean	Median	90% fractile	Maximum						
Farmed trout		30	0,26	1,00	0,61	2,52	2,74						

Denmark						
TEQ total (dioxin & PCB)						
Foodstuff	Number of samples	Minimum	Mean	Median	90%	Maximum
Herring - S. Baltic Sea, w. of Bornholm	10	2,30	3,97	3,60	5,36	5,94
Herring - S. Baltic Sea, e. of Bornholm	9	3,05	7,28	5,47		15,22
Sea Trout , Bornholm	2	9,75	10,58	10,58		11,42

Baltic fish

					Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound
					(WHO-TEQ) pg/g fresh weight			(WHO-TEQ) pg/g fresh weight			(WHO-TEQ) pg/g fresh weight		
Country	**Year**	**Fat content**	**Food category (Muscle meat fish w/ skin, muscle meat of fish w/o skin, fishery products)**	**FOOD**	**DIOXIN + FURANS**	**DIOXIN + FURANS**	**DIOXIN+ FURANS**	**DIOXIN – LIKE PCB**	**DIOXIN – LIKE PCB**	**DIOXIN- LIKE PCB**	**TOTAL**	**TOTAL**	**TOTAL**
Finland	2003	1,98	muscle meat w skin	BS Bream, pool	0,806	0,806	0,805	2,869	2,869	2,869	3,676	3,675	3,675
Finland	2003	6,18	muscle meat w skin	BS Bream, pool	2,240	2,239	2,239	6,303	6,303	6,303	8,543	8,543	8,542
Finland	2003	2,04	muscle meat w skin	BS Bream, pool	2,991	2,991	2,990	7,738	7,738	7,738	10,729	10,729	10,728
Finland	2002	1,70	muscle meat w skin	BS Pike-perch, pool	2,039	2,038	2,038	1,988	1,988	1,988	4,027	4,026	4,026
Finland	2002	1,39	muscle meat w skin	BS Pike-perch, pool	1,659	1,659	1,658	1,745	1,745	1,745	3,404	3,404	3,403
Finland	2002	1,01	muscle meat w skin	BS Pike-perch, pool	0,721	0,721	0,720	0,843	0,843	0,843	1,564	1,563	1,563
Finland	2002	0,94	muscle meat w skin	BS Pike-perch, pool	0,777	0,776	0,776	1,355	1,355	1,355	2,132	2,131	2,131
Finland	2002	3,22	muscle meat w skin	BS Perch, pool	2,738	2,734	2,730	3,024	3,024	3,024	5,762	5,758	5,754
Finland	2002	2,66	muscle meat w skin	BS Perch, pool	4,225	4,222	4,219	4,297	4,297	4,297	8,522	8,519	8,516
Finland	2002	1,22	muscle meat w skin	BS Perch, pool	1,846	1,845	1,845	2,038	2,038	2,038	3,884	3,883	3,883
Finland	2002	1,11	muscle meat w skin	BS Perch, pool	1,507	1,507	1,507	1,903	1,903	1,903	3,410	3,410	3,410
Finland	2002	0,81	muscle meat w skin	BS Perch, pool	0,529	0,529	0,529	0,690	0,690	0,690	1,220	1,219	1,219
Finland	2002	2,61	muscle meat w skin	BS Perch, pool	5,232	5,231	5,230	4,996	4,996	4,996	10,228	10,227	10,226
Finland	2002	1,31	muscle meat w skin	BS Perch, pool	1,282	1,280	1,278	1,253	1,253	1,253	2,535	2,533	2,531
Finland	2002	1,31	muscle meat w skin	BS Perch, pool	1,179	1,176	1,174	1,115	1,115	1,115	2,294	2,291	2,289
Finland	2003	2,23	muscle meat w skin	BS Perch, pool	0,939	0,939	0,939	1,104	1,104	1,104	2,043	2,043	2,043
Finland	2003	2,44	muscle meat w skin	BS Perch, pool	2,285	2,285	2,285	2,435	2,435	2,435	4,720	4,720	4,720
Finland	2003	4,15	muscle meat w skin	BS Perch, pool	3,476	3,475	3,475	2,997	2,997	2,997	6,473	6,472	6,472
Finland	2002	0,52	muscle meat w skin	BS Pike, pool	0,945	0,945	0,945	1,124	1,124	1,124	2,069	2,069	2,069
Finland	2002	0,35	muscle meat w skin	BS Pike, pool	0,447	0,447	0,447	0,471	0,471	0,471	0,918	0,918	0,918
Finland	2002	0,65	muscle meat w skin	BS Pike, pool	1,388	1,388	1,388	1,370	1,370	1,370	2,758	2,758	2,758
Finland	2002	0,50	muscle meat w skin	BS Pike, pool	1,313	1,313	1,313	1,674	1,674	1,674	2,987	2,987	2,987
Finland	2002	0,70	muscle meat w skin	BS Pike, pool	0,617	0,617	0,617	0,780	0,780	0,780	1,397	1,397	1,397
Finland	2002	0,39	muscle meat w skin	BS Pike, pool	0,710	0,710	0,710	0,907	0,907	0,907	1,617	1,617	1,617
Finland	2003	4,31	muscle meat w skin	BS Vendace, pool	0,409	0,406	0,402	0,290	0,290	0,290	0,699	0,696	0,692
Finland	2003	5,44	muscle meat w skin	BS Vendace, pool	0,578	0,574	0,569	0,424	0,424	0,424	1,001	0,997	0,993
Finland	2003	5,48	muscle meat w skin	BS Vendace, pool	0,843	0,839	0,835	0,627	0,627	0,627	1,470	1,466	1,462
Finland	2002	2,06	muscle meat w skin	BS Whitefish, pool	1,204	1,202	1,201	1,352	1,352	1,352	2,556	2,554	2,553
Finland	2002	3,55	muscle meat w skin	BS Whitefish, pool	1,204	1,200	1,196	1,493	1,493	1,493	2,697	2,693	2,689
Finland	2002	2,41	muscle meat w skin	BS Whitefish, pool	1,622	1,622	1,621	1,790	1,790	1,790	3,412	3,412	3,411
Finland	2002	5,03	muscle meat w skin	BS Whitefish, pool	3,210	3,209	3,207	2,634	2,634	2,634	5,844	5,843	5,841
Finland	2002	4,25	muscle meat w skin	BS Whitefish, pool	3,843	3,842	3,841	2,393	2,393	2,393	6,236	6,235	6,234
Finland	2002	2,58	muscle meat w skin	BS Whitefish, pool	7,068	7,068	7,068	3,753	3,753	3,753	10,821	10,821	10,821
Finland	2003	4,53	muscle meat w skin	BS Whitefish, pool	2,650	2,647	2,644	2,009	2,009	2,009	4,658	4,655	4,653
Finland	2003	3,76	muscle meat w skin	BS Whitefish, pool	1,501	1,499	1,498	1,821	1,821	1,821	3,322	3,320	3,319
Finland	2003	3,69	muscle meat w skin	BS Whitefish, pool	2,772	2,769	2,767	1,835	1,835	1,835	4,607	4,604	4,602
Finland	2003	2,67	muscle meat w skin	BS Whitefish, pool	2,989	2,987	2,986	1,878	1,878	1,878	4,867	4,866	4,864
Finland	2003	1,12	muscle meat w skin	BS Roach, pool	0,402	0,400	0,399	0,877	0,877	0,877	1,279	1,278	1,276
Finland	2003	1,77	muscle meat w skin	BS Roach, pool	0,398	0,397	0,396	1,430	1,430	1,430	1,828	1,827	1,826
Finland	2003	1,70	muscle meat w skin	BS Roach, pool	0,725	0,724	0,724	1,763	1,763	1,763	2,488	2,488	2,487
Finland	2002	8,43	muscle meat w skin	BS Sprat, pool	0,882	0,879	0,876	0,965	0,965	0,965	1,847	1,844	1,840
Finland	2002	14,10	muscle meat w skin	BS Sprat, pool	2,038	2,037	2,036	1,919	1,919	1,919	3,957	3,956	3,955
Finland	2002	9,50	muscle meat w skin	BS Sprat, pool	2,983	2,982	2,980	3,081	3,081	3,081	6,064	6,063	6,061
Finland	2002	9,64	muscle meat w skin	BS Sprat, pool	2,720	2,719	2,718	2,830	2,830	2,830	5,550	5,549	5,548
Finland	2002	5,31	muscle meat w skin	BS Salmon, pool	2,316	2,313	2,310	3,712	3,712	3,712	6,028	6,025	6,022
Finland	2002	7,67	muscle meat w skin	BS Salmon, pool	3,210	3,204	3,198	4,901	4,901	4,901	8,111	8,105	8,099
Finland	2002	11,60	muscle meat w skin	BS Salmon, pool	8,774	8,773	8,772	12,600	12,600	12,600	21,374	21,373	21,372
Finland	2002	13,30	muscle meat w skin	BS Salmon, pool	9,701	9,700	9,698	15,300	15,300	15,300	25,001	25,000	24,998
Finland	2002	19,10	muscle meat w skin	BS Salmon, pool	14,550	14,540	14,540	13,100	13,100	13,100	27,650	27,640	27,640
Finland	2002	16,90	muscle meat w skin	BS Salmon, pool	17,380	17,370	17,370	15,600	15,600	15,600	32,980	32,970	32,970
Finland	2002	17,40	muscle meat w skin	BS Salmon, pool	10,790	10,790	10,790	10,700	10,700	10,700	21,490	21,490	21,490
Finland	2002	16,70	muscle meat w skin	BS Salmon, pool	15,670	15,670	15,660	14,300	14,300	14,300	29,970	29,970	29,960
Finland	2003	17,59	muscle meat w skin	BS Salmon, individual	9,265	9,254	9,244	14,200	14,200	14,195	23,465	23,454	23,439
Finland	2003	16,75	muscle meat w/o skin	BS Salmon, individual	8,134	8,125	8,115	13,500	13,500	13,527	21,634	21,625	21,643
Finland	2003	20,68	muscle meat w skin	BS Salmon, individual	9,115	9,099	9,082	13,600	13,600	13,641	22,715	22,699	22,723
Finland	2003	16,89	muscle meat w/o skin	BS Salmon, individual	7,249	7,239	7,230	11,000	11,000	11,022	18,249	18,239	18,252
Finland	2002	9,80	muscle meat w skin	BS Flounder, pool	1,397	1,386	1,376	1,777	1,777	1,777	3,174	3,163	3,153
Finland	2002	10,30	muscle meat w skin	BS Flounder, pool	2,287	2,279	2,271	4,036	4,036	4,036	6,323	6,315	6,307
Finland	2003	8,11	muscle meat w skin	BS Flounder, pool	1,279	1,273	1,267	2,173	2,173	2,173	3,453	3,446	3,440

Baltic fish

Country	Year	Fat content	Food category (Muscle meat fish w/ skin, muscle meat of fish w/o skin, fishery products)	FOOD	DIOXIN + FURANS Upper Bound (WHO-TEQ) pg/g fresh weight	DIOXIN + FURANS Medium Bound	DIOXIN+ FURANS Lower Bound	DIOXIN – LIKE PCB Upper Bound (WHO-TEQ) pg/g fresh weight	DIOXIN – LIKE PCB Medium Bound	DIOXIN-LIKE PCB Lower Bound	TOTAL Upper Bound (WHO-TEQ) pg/g fresh weight	TOTAL Medium Bound	TOTAL Lower Bound
Finland	2003	4,88	muscle meat w skin	BS Flounder, pool	1,476	1,472	1,467	4,505	4,505	4,505	5,981	5,977	5,973
Finland	spring 2002	1,65	muscle meat w skin	BS Baltic Herring, pool	0,782	0,782	0,782	0,908	0,908	0,908	1,690	1,690	1,690
Finland	spring 2002	3,39	muscle meat w skin	BS Baltic Herring, pool	1,288	1,287	1,286	1,389	1,389	1,389	2,677	2,676	2,675
Finland	spring 2002	13,60	muscle meat w skin	BS Baltic Herring, pool	2,314	2,309	2,305	1,935	1,935	1,935	4,249	4,244	4,240
Finland	spring 2002	5,27	muscle meat w skin	BS Baltic Herring, pool	2,024	2,023	2,021	1,828	1,828	1,828	3,852	3,851	3,849
Finland	spring 2002	3,02	muscle meat w skin	BS Baltic Herring, pool	4,603	4,603	4,602	3,105	3,105	3,105	7,708	7,708	7,707
Finland	spring 2002	4,40	muscle meat w skin	BS Baltic Herring, pool	7,404	7,403	7,401	3,845	3,845	3,845	11,249	11,248	11,246
Finland	spring 2002	3,67	muscle meat w skin	BS Baltic Herring, pool	5,027	5,026	5,025	2,775	2,775	2,775	7,802	7,801	7,800
Finland	spring 2002	10,80	muscle meat w skin	BS Baltic Herring, pool	7,520	7,517	7,515	5,979	5,979	5,979	13,499	13,496	13,494
Finland	spring 2002	4,72	muscle meat w skin	BS Baltic Herring, pool	1,418	1,417	1,415	1,051	1,051	1,051	2,469	2,468	2,466
Finland	spring 2002	4,38	muscle meat w skin	BS Baltic Herring, pool	3,250	3,248	3,247	2,286	2,286	2,286	5,536	5,534	5,533
Finland	spring 2002	6,20	muscle meat w skin	BS Baltic Herring, pool	4,443	4,441	4,440	3,230	3,230	3,230	7,673	7,671	7,670
Finland	spring 2002	4,94	muscle meat w skin	BS Baltic Herring, pool	6,575	6,574	6,574	3,756	3,756	3,756	10,331	10,330	10,330
Finland	spring 2002	4,86	muscle meat w skin	BS Baltic Herring, pool	3,127	3,125	3,124	3,112	3,112	3,112	6,239	6,237	6,236
Finland	spring 2002	4,04	muscle meat w skin	BS Baltic Herring, pool	1,962	1,961	1,961	1,100	1,100	1,100	3,062	3,061	3,061
Finland	spring 2002	2,50	muscle meat w skin	BS Baltic Herring, pool	2,487	2,486	2,486	1,402	1,402	1,402	3,889	3,888	3,888
Finland	spring 2002	3,45	muscle meat w skin	BS Baltic Herring, pool	6,584	6,584	6,583	2,849	2,849	2,849	9,433	9,433	9,432
Finland	spring 2002	5,49	muscle meat w skin	BS Baltic Herring, pool	13,360	13,360	13,360	5,333	5,333	5,333	18,693	18,693	18,693
Finland	spring 2002	5,85	muscle meat w skin	BS Baltic Herring, pool	17,200	17,200	17,200	7,306	7,306	7,306	24,506	24,506	24,506
Finland	spring 2002	6,22	muscle meat w skin	BS Baltic Herring, pool	2,003	2,003	2,003	1,200	1,200	1,200	3,203	3,203	3,203
Finland	spring 2002	5,84	muscle meat w skin	BS Baltic Herring, pool	2,520	2,520	2,520	1,449	1,449	1,449	3,969	3,969	3,969
Finland	spring 2002	7,38	muscle meat w skin	BS Baltic Herring, pool	8,225	8,225	8,225	3,427	3,427	3,427	11,652	11,652	11,652
Finland	spring 2002	9,24	muscle meat w skin	BS Baltic Herring, pool	15,870	15,870	15,870	6,321	6,321	6,321	22,191	22,191	22,191
Finland	spring 2002	7,07	muscle meat w skin	BS Baltic Herring, pool	16,590	16,590	16,590	6,466	6,466	6,466	23,056	23,056	23,056
Finland	spring 2002	5,19	muscle meat w skin	BS Baltic Herring, pool	2,292	2,290	2,289	1,266	1,266	1,266	3,558	3,556	3,555
Finland	spring 2002	4,42	muscle meat w skin	BS Baltic Herring, pool	3,672	3,671	3,670	2,139	2,139	2,139	5,811	5,810	5,809
Finland	spring 2002	4,67	muscle meat w skin	BS Baltic Herring, pool	10,940	10,940	10,940	5,132	5,132	5,132	16,072	16,072	16,072
Finland	spring 2002	2,73	muscle meat w skin	BS Baltic Herring, pool	11,190	11,190	11,190	4,760	4,760	4,760	15,950	15,950	15,950
Finland	spring 2002	2,39	muscle meat w skin	BS Baltic Herring, pool	17,720	17,720	17,720	6,610	6,610	6,610	24,330	24,330	24,330
Finland	spring 2002	24,70	muscle meat w skin	BS Baltic Herring, fried	9,601	9,593	9,586	4,463	4,463	4,463	14,064	14,056	14,049
Finland	spring 2002	24,96	muscle meat w skin	BS Baltic Herring, fried	10,640	10,630	10,630	5,020	5,020	5,020	15,660	15,650	15,650
Finland	spring 2002	26,56	muscle meat w skin	BS Baltic Herring, fried	11,420	11,410	11,400	5,344	5,344	5,344	16,764	16,754	16,744
Finland	spring 2002	5,97	muscle meat w/o skir	BS Baltic Herring, pool	3,426	3,425	3,424	1,821	1,821	1,821	5,247	5,246	5,245
Finland	spring 2002	6,70	muscle meat w/o skir	BS Baltic Herring, pool	3,115	3,114	3,112	1,738	1,738	1,738	4,853	4,852	4,850
Finland	spring 2002	5,98	muscle meat w/o skir	BS Baltic Herring, pool	3,499	3,497	3,495	1,795	1,795	1,795	5,294	5,292	5,290
Finland	spring 2002	10,80	muscle meat w skin	BS Baltic Herring, marinated	13,000	13,000	13,000	6,106	6,106	6,106	19,106	19,106	19,106
Finland	spring 2002	9,41	muscle meat w skin	BS Baltic Herring, marinated	11,100	11,100	11,100	5,212	5,212	5,212	16,312	16,312	16,312
Finland	spring 2002	10,70	muscle meat w skin	BS Baltic Herring, marinated	13,900	13,900	13,900	6,591	6,591	6,591	20,491	20,491	20,491
Finland	spring 2002	8,15	muscle meat w/o skir	BS Baltic Herring, smoked	9,461	9,459	9,458	4,725	4,725	4,725	14,186	14,184	14,183
Finland	spring 2002	8,01	muscle meat w/o skir	BS Baltic Herring, smoked	12,100	12,100	12,100	6,197	6,197	6,197	18,297	18,297	18,297
Finland	spring 2002	11,00	muscle meat w skin	BS Baltic Herring, smoked	17,300	17,300	17,300	8,176	8,176	8,176	25,476	25,476	25,476
Finland	spring 2002	11,50	muscle meat w skin	BS Baltic Herring, smoked	20,000	20,000	20,000	9,528	9,528	9,528	29,528	29,528	29,528
Finland	fall 2002	8,78	muscle meat w skin	BS Baltic Herring, pool	1,126	1,123	1,121	1,045	1,044	1,043	2,171	2,167	2,164
Finland	fall 2002	8,68	muscle meat w skin	BS Baltic Herring, pool	1,859	1,856	1,852	1,542	1,541	1,539	3,401	3,397	3,391
Finland	fall 2002	8,72	muscle meat w skin	BS Baltic Herring, pool	5,700	5,699	5,697	3,695	3,695	3,695	9,395	9,394	9,392
Finland	fall 2002	7,79	muscle meat w skin	BS Baltic Herring, pool	0,768	0,766	0,764	0,728	0,721	0,714	1,496	1,487	1,478
Finland	fall 2002	8,66	muscle meat w skin	BS Baltic Herring, pool	1,785	1,784	1,782	1,541	1,540	1,539	3,326	3,324	3,321
Finland	fall 2002	7,70	muscle meat w skin	BS Baltic Herring, pool	0,876	0,873	0,870	0,780	0,773	0,766	1,655	1,645	1,636
Finland	fall 2002	8,64	muscle meat w skin	BS Baltic Herring, pool	2,216	2,214	2,213	1,473	1,472	1,471	3,689	3,686	3,684
Finland	fall 2002	7,39	muscle meat w skin	BS Baltic Herring, pool	1,985	1,983	1,981	1,632	1,632	1,632	3,617	3,615	3,613
Finland	fall 2002	6,06	muscle meat w skin	BS Baltic Herring, pool	1,500	1,499	1,498	1,798	1,798	1,798	3,298	3,297	3,296
Finland	fall 2002	9,12	muscle meat w skin	BS Baltic Herring, pool	2,183	2,180	2,178	3,197	3,197	3,197	5,380	5,377	5,375
Finland	fall 2002	6,44	muscle meat w skin	BS Baltic Herring, pool	0,704	0,695	0,686	0,523	0,523	0,523	1,227	1,218	1,209
Finland	fall 2002	5,96	muscle meat w skin	BS Baltic Herring, pool	2,839	2,838	2,837	1,516	1,516	1,516	4,355	4,354	4,353
Finland	fall 2002	9,14	muscle meat w skin	BS Baltic Herring, pool	6,787	6,787	6,787	3,317	3,317	3,317	10,104	10,104	10,104
Finland	fall 2002	8,02	muscle meat w skin	BS Baltic Herring, pool	14,500	14,500	14,500	5,001	5,001	5,001	19,501	19,501	19,501
Finland	fall 2002	9,66	muscle meat w skin	BS Baltic Herring, pool	13,600	13,600	13,600	7,360	7,360	7,360	20,960	20,960	20,960
Finland	fall 2002	6,10	muscle meat w skin	BS Baltic Herring, pool	0,733	0,725	0,717	0,481	0,481	0,481	1,214	1,206	1,198
Finland	fall 2002	6,27	muscle meat w skin	BS Baltic Herring, pool	2,350	2,348	2,346	1,563	1,563	1,563	3,913	3,911	3,909
Finland	fall 2002	5,52	muscle meat w skin	BS Baltic Herring, pool	4,586	4,584	4,582	2,656	2,656	2,656	7,242	7,240	7,238
Finland	fall 2002	5,98	muscle meat w skin	BS Baltic Herring, pool	6,592	6,590	6,588	3,575	3,575	3,575	10,167	10,165	10,163

Baltic fish

					Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound
					(WHO-TEQ) pg/g fresh weight			(WHO-TEQ) pg/g fresh weight			(WHO-TEQ) pg/g fresh weight		
Country	**Year**	**Fat content**	**Food category (Muscle meat fish w/ skin, muscle meat of fish w/o skin, fishery products)**	**FOOD**	**DIOXIN + FURANS**	**DIOXIN + FURANS**	**DIOXIN+ FURANS**	**DIOXIN – LIKE PCB**	**DIOXIN – LIKE PCB**	**DIOXIN- LIKE PCB**	**TOTAL**	**TOTAL**	**TOTAL**
Finland	spring 2002	11,53	muscle meat w skin	BS Baltic Herring, individua	15,400	15,400	15,400	7,474	7,474	7,474	22,874	22,874	22,874
Finland	spring 2002	12,56	muscle meat w skin	BS Baltic Herring, individua	23,490	23,490	23,490	9,374	9,374	9,374	32,864	32,864	32,864
Finland	spring 2002	7,37	muscle meat w skin	BS Baltic Herring, individua	18,120	18,120	18,120	8,318	8,318	8,318	26,438	26,438	26,438
Finland	spring 2002	3,95	muscle meat w skin	BS Baltic Herring, individua	3,128	3,125	3,121	1,828	1,828	1,828	4,956	4,953	4,949
Finland	spring 2002	7,42	muscle meat w skin	BS Baltic Herring, individua	14,230	14,220	14,220	6,205	6,205	6,205	20,435	20,425	20,425
Finland	spring 2002	4,11	muscle meat w skin	BS Baltic Herring, individua	21,040	21,040	21,040	8,619	8,619	8,619	29,659	29,659	29,659
Finland	spring 2002	8,54	muscle meat w skin	BS Baltic Herring, individua	13,890	13,890	13,890	7,515	7,515	7,515	21,405	21,405	21,405
Finland	spring 2002	8,50	muscle meat w skin	BS Baltic Herring, individua	10,040	10,040	10,040	4,171	4,171	4,171	14,211	14,211	14,211
Finland	spring 2002	11,24	muscle meat w skin	BS Baltic Herring, individua	10,460	10,450	10,450	4,666	4,666	4,666	15,126	15,116	15,116
Finland	spring 2002	3,69	muscle meat w skin	BS Baltic Herring, individua	4,679	4,678	4,677	2,242	2,242	2,242	6,921	6,920	6,919
Finland	spring 2002	5,78	muscle meat w skin	BS Baltic Herring, individua	2,653	2,648	2,644	1,914	1,914	1,914	4,567	4,562	4,558
Finland	spring 2002	6,28	muscle meat w skin	BS Baltic Herring, individua	3,023	3,018	3,013	1,735	1,735	1,735	4,758	4,753	4,748
Finland	spring 2002	0,80	muscle meat w skin	BS Baltic Herring, individua	6,467	6,467	6,466	1,028	1,028	1,028	7,495	7,495	7,494
Finland	spring 2002	8,34	muscle meat w skin	BS Baltic Herring, individua	6,677	6,674	6,671	3,810	3,810	3,810	10,487	10,484	10,481
Finland	spring 2002	6,01	muscle meat w skin	BS Baltic Herring, individua	1,746	1,741	1,736	1,242	1,242	1,242	2,988	2,983	2,978
Finland	spring 2002	6,39	muscle meat w skin	BS Baltic Herring, individua	11,400	11,400	11,400	5,960	5,960	5,960	17,360	17,360	17,360
Finland	spring 2002	13,19	muscle meat w skin	BS Baltic Herring, individua	22,810	22,810	22,810	10,500	10,500	10,500	33,310	33,310	33,310
Finland	spring 2002	7,66	muscle meat w skin	BS Baltic Herring, individua	10,010	10,000	10,000	5,017	5,017	5,017	15,027	15,017	15,017
Finland	spring 2002	7,31	muscle meat w skin	BS Baltic Herring, individua	2,398	2,396	2,394	1,087	1,087	1,087	3,485	3,483	3,481
Finland	spring 2002	7,36	muscle meat w skin	BS Baltic Herring, individua	13,560	13,560	13,560	5,596	5,596	5,596	19,156	19,156	19,156
Finland	spring 2002	10,31	muscle meat w skin	BS Baltic Herring, individua	14,530	14,530	14,520	5,005	5,005	5,005	19,535	19,535	19,525
Finland	spring 2002	14,84	muscle meat w skin	BS Baltic Herring, individua	16,900	16,900	16,900	5,675	5,675	5,675	22,575	22,575	22,575
Finland	spring 2002	8,05	muscle meat w skin	BS Baltic Herring, individua	6,490	6,489	6,489	3,502	3,502	3,502	9,992	9,991	9,991
Finland	spring 2002	7,70	muscle meat w skin	BS Baltic Herring, individua	12,170	12,170	12,170	5,328	5,328	5,328	17,498	17,498	17,498
Finland	spring 2002	6,65	muscle meat w skin	BS Baltic Herring, individua	3,444	3,442	3,440	1,927	1,927	1,927	5,371	5,369	5,367
Finland	spring 2002	3,70	muscle meat w skin	BS Baltic Herring, individua	2,665	2,664	2,663	1,577	1,577	1,577	4,242	4,241	4,240
Finland	spring 2002	8,47	muscle meat w skin	BS Baltic Herring, individua	18,470	18,470	18,460	5,398	5,398	5,398	23,868	23,868	23,858
Finland	spring 2002	7,11	muscle meat w skin	BS Baltic Herring, individua	20,080	20,080	20,080	7,202	7,202	7,202	27,282	27,282	27,282
Finland	spring 2002	9,56	muscle meat w skin	BS Baltic Herring, individua	22,860	22,860	22,860	9,146	9,146	9,146	32,006	32,006	32,006
Finland	spring 2002	5,66	muscle meat w skin	BS Baltic Herring, individua	8,055	8,055	8,055	3,338	3,338	3,338	11,393	11,393	11,393
Finland	spring 2002	10,00	muscle meat w skin	BS Baltic Herring, individua	11,730	11,730	11,730	4,600	4,600	4,600	16,330	16,330	16,330
Finland	spring 2002	10,70	muscle meat w skin	BS Baltic Herring, individua	8,328	8,327	8,326	4,149	4,149	4,149	12,477	12,476	12,475
Finland	spring 2002	3,52	muscle meat w skin	BS Baltic Herring, individua	12,100	12,100	12,100	4,435	4,435	4,435	16,535	16,535	16,535
Finland	spring 2002	14,80	muscle meat w skin	BS Baltic Herring, individua	18,700	18,700	18,700	10,100	10,100	10,100	28,800	28,800	28,800
Finland	spring 2002	6,35	muscle meat w skin	BS Baltic Herring, individua	4,426	4,426	4,425	2,454	2,454	2,454	6,880	6,880	6,879
Finland	spring 2002	12,50	muscle meat w skin	BS Baltic Herring, individua	26,900	26,900	26,900	9,719	9,719	9,719	36,619	36,619	36,619
Finland	spring 2002	6,33	muscle meat w skin	BS Baltic Herring, individua	12,600	12,600	12,600	5,227	5,227	5,227	17,827	17,827	17,827
Finland	spring 2002	5,46	muscle meat w skin	BS Baltic Herring, individua	20,100	20,100	20,100	7,633	7,633	7,633	27,733	27,733	27,733
Finland	spring 2002	4,77	muscle meat w skin	BS Baltic Herring, individua	16,500	16,500	16,500	6,121	6,121	6,121	22,621	22,621	22,621
Finland	spring 2002	3,90	muscle meat w skin	BS Baltic Herring, individua	5,755	5,754	5,753	2,900	2,900	2,900	8,655	8,654	8,653
Finland	spring 2002	4,64	muscle meat w skin	BS Baltic Herring, individua	4,759	4,758	4,758	2,460	2,460	2,460	7,219	7,218	7,218
Finland	spring 2002	6,45	muscle meat w skin	BS Baltic Herring, individua	11,200	11,200	11,200	5,732	5,732	5,732	16,932	16,932	16,932
Finland	spring 2002	7,84	muscle meat w skin	BS Baltic Herring, individua	18,700	18,700	18,700	8,203	8,203	8,203	26,903	26,903	26,903
Finland	spring 2002	4,61	muscle meat w skin	BS Baltic Herring, individua	4,539	4,539	4,539	1,998	1,998	1,998	6,537	6,537	6,537
Finland	spring 2002	6,71	muscle meat w skin	BS Baltic Herring, individua	15,500	15,500	15,500	6,037	6,037	6,037	21,537	21,537	21,537
Finland	spring 2002	7,06	muscle meat w skin	BS Baltic Herring, individua	24,800	24,800	24,800	10,400	10,400	10,400	35,200	35,200	35,200
Finland	spring 2002	10,42	muscle meat w skin	BS Baltic Herring, individua	34,400	34,400	34,400	13,000	13,000	13,000	47,400	47,400	47,400
Finland	spring 2002	10,97	muscle meat w skin	BS Baltic Herring, individua	17,600	17,600	17,600	8,632	8,632	8,632	26,232	26,232	26,232
Finland	spring 2002	5,89	muscle meat w skin	BS Baltic Herring, individua	8,983	8,981	8,980	3,588	3,588	3,588	12,571	12,569	12,568
Finland	spring 2002	6,53	muscle meat w skin	BS Baltic Herring, individua	2,390	2,389	2,388	1,340	1,340	1,340	3,730	3,729	3,728
Finland	spring 2002	2,67	muscle meat w skin	BS Baltic Herring, individua	5,006	5,005	5,004	2,201	2,201	2,201	7,207	7,206	7,205
Finland	spring 2002	6,55	muscle meat w skin	BS Baltic Herring, individua	3,533	3,532	3,530	1,866	1,866	1,866	5,399	5,398	5,396
Finland	spring 2002	4,50	muscle meat w skin	BS Baltic Herring, individua	13,700	13,700	13,700	5,325	5,325	5,325	19,025	19,025	19,025
Finland	spring 2002	5,44	muscle meat w skin	BS Baltic Herring, individua	3,215	3,212	3,210	2,261	2,261	2,261	5,476	5,473	5,471
Finland	spring 2002	7,47	muscle meat w skin	BS Baltic Herring, individua	14,800	14,800	14,800	5,884	5,884	5,884	20,684	20,684	20,684
Finland	spring 2002	12,35	muscle meat w skin	BS Baltic Herring, individua	5,478	5,475	5,473	3,364	3,364	3,364	8,842	8,839	8,837
Finland	spring 2002	11,14	muscle meat w skin	BS Baltic Herring, individua	11,300	11,300	11,300	4,587	4,587	4,587	15,887	15,887	15,887
Finland	spring 2002	7,82	muscle meat w skin	BS Baltic Herring, individua	11,600	11,600	11,600	3,922	3,922	3,922	15,522	15,522	15,522
Finland	spring 2002	8,81	muscle meat w skin	BS Baltic Herring, individua	2,650	2,647	2,643	1,521	1,521	1,521	4,171	4,168	4,164
Finland	spring 2002	9,53	muscle meat w skin	BS Baltic Herring, individua	2,346	2,342	2,337	1,368	1,368	1,368	3,714	3,710	3,705
Finland	spring 2002	3,06	muscle meat w skin	BS Baltic Herring, individua	2,504	2,497	2,491	0,809	0,809	0,809	3,313	3,306	3,300
Finland	spring 2002	12,74	muscle meat w skin	BS Baltic Herring, individua	5,432	5,430	5,429	2,618	2,618	2,618	8,050	8,048	8,047
Finland	spring 2002	7,06	muscle meat w skin	BS Baltic Herring, individua	3,262	3,261	3,260	1,708	1,708	1,708	4,970	4,969	4,968
Finland	spring 2002	7,18	muscle meat w skin	BS Baltic Herring, individua	2,520	2,519	2,518	2,417	2,417	2,417	4,937	4,936	4,935
Finland	spring 2002	6,04	muscle meat w skin	BS Baltic Herring, individua	3,337	3,336	3,336	1,862	1,862	1,862	5,199	5,198	5,198
Finland	spring 2002	2,78	muscle meat w skin	BS Baltic Herring, individua	3,617	3,617	3,616	1,295	1,295	1,295	4,912	4,912	4,911
Finland	spring 2002	2,28	muscle meat w skin	BS Baltic Herring, individua	1,782	1,782	1,782	1,058	1,058	1,058	2,840	2,840	2,840
Finland	spring 2002	3,04	muscle meat w skin	BS Baltic Herring, individua	12,320	12,320	12,320	3,889	3,889	3,889	16,209	16,209	16,209
Finland	spring 2002	8,68	muscle meat w skin	BS Baltic Herring, individua	3,912	3,911	3,910	2,767	2,767	2,767	6,679	6,678	6,677
Finland	spring 2002	7,36	muscle meat w skin	BS Baltic Herring, individua	7,120	7,120	7,120	4,084	4,084	4,084	11,204	11,204	11,204
Finland	spring 2002	10,23	muscle meat w skin	BS Baltic Herring, individua	3,675	3,674	3,673	1,673	1,673	1,673	5,348	5,347	5,346
Finland	spring 2002	3,70	muscle meat w skin	BS Baltic Herring, individua	3,506	3,505	3,505	1,740	1,740	1,740	5,246	5,245	5,245
Finland	spring 2002	6,16	muscle meat w skin	BS Baltic Herring, individua	0,977	0,976	0,976	0,575	0,575	0,575	1,552	1,552	1,551
Finland	spring 2002	5,09	muscle meat w skin	BS Baltic Herring, individua	5,976	5,976	5,976	2,355	2,355	2,355	8,331	8,331	8,331
Finland	spring 2002	7,55	muscle meat w skin	BS Baltic Herring, individua	0,836	0,833	0,830	0,591	0,591	0,591	1,427	1,424	1,421
Finland	spring 2002	8,48	muscle meat w skin	BS Baltic Herring, individua	1,319	1,318	1,317	1,149	1,149	1,149	2,468	2,467	2,466
Finland	spring 2002	3,73	muscle meat w skin	BS Baltic Herring, individua	4,849	4,849	4,848	1,242	1,242	1,242	6,091	6,091	6,090
Finland	spring 2002	3,08	muscle meat w skin	BS Baltic Herring, individua	1,848	1,847	1,847	1,333	1,333	1,333	3,181	3,180	3,180
Finland	spring 2002	5,36	muscle meat w skin	BS Baltic Herring, individua	3,487	3,486	3,486	1,678	1,678	1,678	5,165	5,164	5,164
Finland	spring 2002	7,41	muscle meat w skin	BS Baltic Herring, individua	3,213	3,212	3,211	2,143	2,143	2,143	5,356	5,355	5,354
Finland	spring 2002	7,48	muscle meat w skin	BS Baltic Herring, individua	1,310	1,308	1,306	0,901	0,900	0,898	2,211	2,208	2,204
Finland	spring 2002	7,65	muscle meat w skin	BS Baltic Herring, individua	1,198	1,197	1,196	0,703	0,696	0,689	1,901	1,893	1,885
Finland	spring 2002	6,18	muscle meat w skin	BS Baltic Herring, individua	0,957	0,956	0,956	0,637	0,631	0,625	1,593	1,587	1,581
Finland	spring 2002	4,86	muscle meat w skin	BS Baltic Herring, individua	0,757	0,757	0,756	0,549	0,545	0,540	1,307	1,302	1,296
Finland	spring 2002	10,91	muscle meat w skin	BS Baltic Herring, individua	4,013	4,012	4,011	1,260	1,260	1,260	5,273	5,272	5,271
Finland	spring 2002	11,19	muscle meat w skin	BS Baltic Herring, individua	1,962	1,960	1,959	1,320	1,310	1,300	3,282	3,270	3,259
Finland	spring 2002	9,18	muscle meat w skin	BS Baltic Herring, individua	2,867	2,866	2,865	1,777	1,777	1,777	4,644	4,643	4,642
Finland	spring 2002	10,10	muscle meat w skin	BS Baltic Herring, individua	2,203	2,202	2,201	1,181	1,172	1,163	3,384	3,374	3,364
Finland	spring 2002	6,45	muscle meat w skin	BS Baltic Herring, individua	1,965	1,965	1,964	1,180	1,180	1,180	3,145	3,145	3,144
Finland	spring 2002	9,93	muscle meat w skin	BS Baltic Herring, individua	2,648	2,647	2,646	1,891	1,889	1,888	4,539	4,536	4,534

Baltic fish					Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound
					(WHO-TEQ) pg/g fresh weight			(WHO-TEQ) pg/g fresh weight			(WHO-TEQ) pg/g fresh weight		
Country	**Year**	**Fat content**	**Food category (Muscle meat fish w/ skin, muscle meat of fish w/o skin, fishery products)**	**FOOD**	**DIOXIN + FURANS**	**DIOXIN + FURANS**	**DIOXIN+ FURANS**	**DIOXIN – LIKE PCB**	**DIOXIN – LIKE PCB**	**DIOXIN-LIKE PCB**	**TOTAL**	**TOTAL**	**TOTAL**
Sweden	2004	8,05	whole fish w/o head	Sprat (Baltic)	3,600	3,600	3,600	3,500	3,500	3,500	7,100	7,100	7,100
Sweden	2004	8,5	whole fish w/o head	Sprat (Baltic)	3,100	3,100	3,100	2,900	2,900	2,900	6,000	6,000	6,000
Sweden	2004	7,34	whole fish w/o head	Sprat (Baltic)	3,300	3,300	3,300	3,300	3,300	3,300	6,600	6,600	6,600
Sweden	2004	8,8	whole fish w/o head	Sprat (Baltic)	3,000	3,000	3,000	2,800	2,800	2,800	5,800	5,800	5,800
Sweden	2003	5,12	muscle meat w skin	Herring (Baltic)	12,000	12,000	12,000	6,100	6,100	6,100	18,100	18,100	18,100
Sweden	2003	7,87	muscle meat w skin	Herring (Baltic)	12,000	12,000	12,000	6,500	6,500	6,500	18,500	18,500	18,500
Sweden	2003	10,11	muscle meat w skin	Herring (Baltic)	10,000	10,000	10,000	5,900	5,900	5,900	15,900	15,900	15,900
Sweden	2003	7,57	muscle meat w/o skin	Herring (Baltic)	7,500	7,500	7,500	4,300	4,300	4,300	11,800	11,800	11,800
Sweden	2003	9,23	muscle meat w/o skin	Smoked herring (Baltic)	12,000	12,000	12,000	6,100	6,100	6,100	18,100	18,100	18,100
Sweden	2002	6,09	muscle meat w/o skin	Salmon (Baltic)	4,900	4,800	4,800	8,100	8,100	8,100	13,000	12,900	12,900
Sweden	2002	7,21	muscle meat w/o skin	Salmon (Baltic)	5,200	5,200	5,200	7,800	7,800	7,800	13,000	13,000	13,000
Sweden	2002	7,62	muscle meat w/o skin	Salmon (Baltic)	5,600	5,500	5,500	8,900	8,900	8,900	14,500	14,400	14,400
Sweden	2002	7,31	muscle meat w/o skin	Salmon (Baltic)	5,900	5,900	5,900	9,200	9,200	9,200	15,100	15,100	15,100
Sweden	2002	8,09	muscle meat w/o skin	Salmon (Baltic)	4,900	4,900	4,900	6,700	6,700	6,700	11,600	11,600	11,600
Sweden	2002	8,17	muscle meat w/o skin	Salmon (Baltic)	5,700	5,700	5,700	7,100	7,100	7,100	12,800	12,800	12,800
Sweden	2002	6,96	muscle meat w/o skin	Salmon (Baltic)	5,800	5,800	5,800	8,300	8,300	8,300	14,100	14,100	14,100
Sweden	2002	7,29	muscle meat w/o skin	Salmon (Baltic)	5,700	5,700	5,700	8,700	8,700	8,700	14,400	14,400	14,400
Sweden	2002	4,77	muscle meat w/o skin	Salmon (Baltic)	2,300	2,300	2,300	4,300	4,200	4,200	6,600	6,500	6,500
Sweden	2002	6,08	muscle meat w/o skin	Salmon (Baltic)	3,000	2,900	2,900	5,700	5,700	5,700	8,700	8,600	8,600
Sweden	2002	6,01	muscle meat w/o skin	Salmon (Baltic)	3,000	3,000	3,000	5,600	5,500	5,500	8,600	8,500	8,500
Sweden	2002	9,03	muscle meat w/o skin	Salmon (Baltic)	4,800	4,800	4,800	8,400	8,400	8,400	13,200	13,200	13,200
Sweden	2002	9,6	muscle meat w/o skin	Salmon (Baltic)	5,100	5,100	5,100	9,300	9,300	9,300	14,400	14,400	14,400
Sweden	2002	9,28	muscle meat w/o skin	Salmon (Baltic)	5,400	5,400	5,400	9,600	9,600	9,600	15,000	15,000	15,000
Sweden	2002	0,91	muscle meat w/o skin	Turbot (Baltic)	0,780	0,780	0,780	0,780	0,780	0,770	1,560	1,560	1,550
Sweden	2002	0,87	muscle meat w/o skin	Turbot (Baltic)	0,980	0,980	0,980	0,920	0,920	0,910	1,900	1,900	1,890
Sweden	2002	0,79	muscle meat w/o skin	Turbot (Baltic)	0,460	0,460	0,460	0,440	0,430	0,420	0,900	0,890	0,880
Sweden	2002	0,6	muscle meat w/o skin	Turbot (Baltic)	0,490	0,480	0,480	0,530	0,520	0,510	1,020	1,000	0,990
Sweden	2002	0,62	muscle meat w/o skin	Turbot (Baltic)	0,840	0,840	0,840	0,880	0,870	0,870	1,720	1,710	1,710
Sweden	2002	0,69	muscle meat w/o skin	Turbot (Baltic)	0,890	0,890	0,890	0,940	0,940	0,940	1,830	1,830	1,830
Sweden	2002	10,4	muscle meat w skin	Herring (Baltic)	5,100	5,100	5,100	5,000	5,000	5,000	10,100	10,100	10,100
Sweden	2002	10,1	muscle meat w skin	Herring (Baltic)	4,600	4,600	4,600	4,600	4,600	4,600	9,200	9,200	9,200
Sweden	2002	3,92	muscle meat w skin	Herring (Baltic)	3,000	3,000	3,000	2,800	2,800	2,800	5,800	5,800	5,800
Sweden	2002	6,95	muscle meat w skin	Herring (Baltic)	1,600	1,600	1,600	2,100	2,100	2,000	3,700	3,700	3,600
Sweden	2002	2,41	muscle meat w skin	Herring (Baltic)	1,500	1,500	1,500	2,000	1,900	1,900	3,500	3,400	3,400
Sweden	2002	2,16	muscle meat w skin	Herring (Baltic)	1,600	1,600	1,500	1,800	1,700	1,700	3,400	3,300	3,200
Sweden	2002	7,15	muscle meat w skin	Herring (Baltic)	1,800	1,800	1,800	2,000	2,000	1,900	3,800	3,800	3,700
Sweden	2002	3,64	muscle meat w/o skin	Herring (Baltic)	0,860	0,850	0,850	1,000	0,970	0,920	1,860	1,820	1,770
Sweden	2002	3,59	muscle meat w/o skin	Herring (Baltic)	0,770	0,760	0,760	0,950	0,880	0,800	1,720	1,640	1,560
Sweden	2002	7,38	muscle meat w skin	Herring (Baltic)	1,600	1,600	1,600	2,100	2,000	2,000	3,700	3,600	3,600
Sweden	2002	13	muscle meat w skin	Sprat (Baltic)	3,500	3,500	3,500	3,600	3,500	3,500	7,100	7,000	7,000
Sweden	2002	10,58	muscle meat w skin	Sprat (Baltic)	3,400	3,400	3,400	3,500	3,400	3,400	6,900	6,800	6,800
Sweden	2002	11,2	muscle meat w skin	Sprat (Baltic)	3,800	3,800	3,800	3,800	3,700	3,700	7,600	7,500	7,500
Sweden	2002	11,2	muscle meat w skin	Sprat (Baltic)	3,300	3,300	3,300	3,400	3,400	3,300	6,700	6,700	6,600
Sweden	2002	7,06	muscle meat w skin	Sprat (Baltic)	3,100	3,100	3,100	3,400	3,400	3,400	6,500	6,500	6,500
Sweden	2002	7,91	muscle meat w skin	Sprat (Baltic)	2,800	2,800	2,800	3,000	3,000	2,900	5,800	5,800	5,700
Sweden	2000	11,9	roe	Vendace, roe (Baltic)	1,900	1,900	1,900	1,500	1,400	1,400	3,400	3,300	3,300
Sweden	2000	13,5	muscle meat w/o skin	Eel (Baltic)	0,640	0,640	0,640	3,800	3,700	3,700	4,440	4,340	4,340
Sweden	2000	17,1	muscle meat w/o skin	Eel (Baltic)	0,740	0,740	0,740	4,100	4,100	4,000	4,840	4,840	4,740
Sweden	2000	14,1	muscle meat w/o skin	Eel (Baltic)	0,680	0,670	0,670	3,100	3,000	3,000	3,780	3,670	3,670
Sweden	2000	18,7	muscle meat w/o skin	Eel (Baltic)	0,700	0,700	0,700	2,300	2,300	2,200	3,000	3,000	2,900
Sweden	2001	24	muscle meat w/o skin	Eel (Baltic)	1,500	1,500	1,500	6,200	6,100	6,000	7,700	7,600	7,500
Sweden	2001	19,6	muscle meat w/o skin	Eel (Baltic)	0,970	0,970	0,960	3,600	3,500	3,400	4,570	4,470	4,360
Sweden	2001	2,9	muscle meat w/o skin	Brown trout (B)	4,800	4,800	4,800	5,800	5,800	5,800	10,600	10,600	10,600
Sweden	2001	2,7	muscle meat w/o skin	Brown trout (B)	3,800	3,800	3,800	5,100	5,100	5,000	8,900	8,900	8,800
Sweden	2001	4,4	muscle meat w/o skin	Brown trout (B)	4,600	4,600	4,600	4,800	4,800	4,800	9,400	9,400	9,400
Sweden	2001	3,9	muscle meat w/o skin	Brown trout (B)	3,500	3,500	3,500	3,800	3,800	3,800	7,300	7,300	7,300
Sweden	2001	3,3	muscle meat w/o skin	Brown trout (B)	3,900	3,900	3,900	3,800	3,700	3,700	7,700	7,600	7,600
Sweden	2001	4,1	muscle meat w/o skin	Brown trout (B)	3,800	3,800	3,800	4,000	4,000	4,000	7,800	7,800	7,800
Sweden	2001	3,3	muscle meat w/o skin	Brown trout (B)	2,600	2,600	2,600	5,600	5,600	5,600	8,200	8,200	8,200
Sweden	2001	3	muscle meat w/o skin	Brown trout (B)	2,900	2,900	2,900	5,900	5,900	5,900	8,800	8,800	8,800
Sweden	2001	3,4	muscle meat w/o skin	Salmon (Baltic)	7,800	7,800	7,800	7,600	7,600	7,600	15,400	15,400	15,400
Sweden	2001	2,9	muscle meat w/o skin	Salmon (Baltic)	3,100	3,100	3,100	5,300	5,300	5,200	8,400	8,400	8,300
Sweden	2001	3,3	muscle meat w/o skin	Salmon (Baltic)	5,300	5,300	5,300	6,000	6,000	6,000	11,300	11,300	11,300
Sweden	2001	2,5	muscle meat w/o skin	Salmon (Baltic)	4,800	4,800	4,800	5,200	5,200	5,100	10,000	10,000	9,900
Sweden	2001	3,9	muscle meat w/o skin	Salmon (Baltic)	3,900	3,900	3,900	4,800	4,800	4,800	8,700	8,700	8,700
Sweden	2001	4	muscle meat w/o skin	Salmon (Baltic)	3,700	3,700	3,700	4,800	4,800	4,800	8,500	8,500	8,500
Sweden	2001	2,7	muscle meat w/o skin	Salmon (Baltic)	3,700	3,700	3,700	8,000	8,000	8,000	11,700	11,700	11,700
Sweden	2001	3,2	muscle meat w/o skin	Salmon (Baltic)	3,800	3,800	3,700	7,200	7,200	7,100	11,000	11,000	10,800
Sweden	2000	11,5	muscle meat w/o skin	Salmon (Baltic)	3,800	3,800	3,700	6,100	6,100	6,100	9,900	9,900	9,800
Sweden	2000	9,5	muscle meat w/o skin	Salmon (Baltic)	3,100	3,100	3,100	5,700	5,700	5,700	8,800	8,800	8,800
Sweden	2001	1,7	muscle meat w/o skin	Whitefish (Baltic)	1,100	1,100	1,100	1,200	1,200	1,200	2,300	2,300	2,300
Sweden	2001	1,4	muscle meat w/o skin	Whitefish (Baltic)	0,710	0,710	0,710	0,670	0,640	0,620	1,380	1,350	1,330
Sweden	2001	1,2	muscle meat w/o skin	Whitefish (Baltic)	1,900	1,900	1,900	1,500	1,500	1,500	3,400	3,400	3,400
Sweden	2001	1	muscle meat w/o skin	Whitefish (Baltic)	1,700	1,700	1,700	1,500	1,500	1,500	3,200	3,200	3,200
Sweden	2001	1,2	muscle meat w/o skin	Whitefish (Baltic)	0,810	0,810	0,810	0,680	0,660	0,630	1,490	1,470	1,440
Sweden	2001	1,2	muscle meat w/o skin	Whitefish (Baltic)	1,000	1,000	1,000	0,750	0,720	0,700	1,750	1,720	1,700
Sweden	2002	7,1	muscle meat w skin	Sprat (Baltic)	2,700	2,700	2,700	3,900	3,900	3,900	6,600	6,600	6,600
Sweden	2002	10,6	muscle meat w skin	Sprat (Baltic)	2,400	2,400	2,400	3,800	3,800	3,800	6,200	6,200	6,200
Sweden	2002	9,1	muscle meat w skin	Sprat (Baltic)	3,600	3,600	3,600	3,900	3,900	3,800	7,500	7,500	7,400
Sweden	2002	12,2	muscle meat w skin	Sprat (Baltic)	2,200	2,200	2,200	1,400	1,300	1,300	3,600	3,500	3,500
Sweden	2002	0,6	muscle meat w/o skin	Cod (Baltic)	0,200	0,190	0,190	0,290	0,280	0,270	0,490	0,470	0,460
Sweden	2000	9	muscle meat w skin	Herring (Baltic)	6,800	6,800	6,800	4,800	4,700	4,700	11,600	11,500	11,500
Sweden	2000	7,8	muscle meat w skin	Herring (Baltic)	4,600	4,600	4,600	3,600	3,600	3,600	8,200	8,200	8,200
Sweden	2000	11	muscle meat w skin	Herring (Baltic)	6,700	6,700	6,700	6,100	6,100	6,100	12,800	12,800	12,800
Sweden	2000	9,6	muscle meat w skin	Herring (Baltic)	5,300	5,300	5,300	4,200	4,200	4,200	9,500	9,500	9,500
Sweden	2000	7,3	muscle meat w skin	Herring (Baltic)	4,700	4,700	4,700	3,400	3,400	3,400	8,100	8,100	8,100
Sweden	2000	8	muscle meat w skin	Herring (Baltic)	4,500	4,500	4,500	3,400	3,400	3,400	7,900	7,900	7,900
Sweden	2000	13,3	muscle meat w skin	Herring (Baltic)	9,900	9,900	9,900	7,500	7,500	7,500	17,400	17,400	17,400
Sweden	2000	15,4	muscle meat w skin	Herring (Baltic)	10,300	10,300	10,300	7,800	7,800	7,800	18,100	18,100	18,100
Sweden	2000	11,5	muscle meat w skin	Herring (Baltic)	10,800	10,800	10,800	14,000	14,000	14,000	24,800	24,800	24,800
Sweden	2000	11,1	muscle meat w skin	Herring (Baltic)	7,200	7,200	7,200	6,700	6,700	6,700	13,900	13,900	13,900
Sweden	2000	3,8	muscle meat w skin	Herring (Baltic)	1,700	1,700	1,700	1,400	1,400	1,300	3,100	3,100	3,000
Sweden	2000	5,3	muscle meat w skin	Herring (Baltic)	1,900	1,900	1,900	1,700	1,700	1,600	3,600	3,600	3,500
Sweden	2000	6,5	muscle meat w skin	Herring (Baltic)	2,900	2,900	2,900	2,300	2,300	2,300	5,200	5,200	5,200
Sweden	2000	5,8	muscle meat w skin	Herring (Baltic)	2,600	2,600	2,600	2,100	2,100	2,100	4,700	4,700	4,700
Sweden	2001	5	muscle meat w skin	Herring (Baltic)	1,100	1,100	1,100	0,830	0,760	0,680	1,930	1,860	1,780
Sweden	2001	5,5	muscle meat w skin	Herring (Baltic)	1,400	1,400	1,400	1,010	0,960	0,910	2,410	2,360	2,310
Sweden	2001	4,6	muscle meat w skin	Herring (Baltic)	3,800	3,800	3,800	2,000	2,000	1,900	5,800	5,800	5,700
Sweden	2001	5,9	muscle meat w skin	Herring (Baltic)	0,860	0,860	0,860	0,820	0,660	0,500	1,680	1,520	1,360
Sweden	2001	4,7	muscle meat w skin	Herring (Baltic)	2,000	2,000	2,000	1,030	0,980	0,930	3,030	2,980	2,930
Sweden	2001	3,7	muscle meat w skin	Herring (Baltic)	3,500	3,500	3,500	1,500	1,500	1,400	5,000	5,000	4,900
Sweden	2001	4,5	muscle meat w skin	Herring (Baltic)	2,500	2,500	2,500	1,300	1,300	1,200	3,800	3,800	3,700
Sweden	2001	5,7	muscle meat w skin	Herring (Baltic)	3,800	3,700	3,700	1,700	1,700	1,600	5,500	5,400	5,300
Sweden	2001	11,1	muscle meat w skin	Herring (Baltic)	10,000	10,000	10,000	6,200	6,200	6,200	16,200	16,200	16,200
Sweden	2001	14,3	muscle meat w skin	Herring (Baltic)	17,000	17,000	17,000	9,900	9,900	9,900	26,900	26,900	26,900
Sweden	2001	10,9	muscle meat w skin	Herring (Baltic)	10,000	10,000	10,000	5,100	5,100	5,100	15,100	15,100	15,100
Sweden	2001	15,5	muscle meat w skin	Herring (Baltic)	20,000	20,000	20,000	10,000	10,000	10,000	30,000	30,000	30,000
Sweden	2001	10,9	muscle meat w skin	Herring (Baltic)	19,000	19,000	19,000	8,300	8,300	8,300	27,300	27,300	27,300
Sweden	2001	11,5	muscle meat w skin	Herring (Baltic)	17,000	17,000	17,000	7,500	7,500	7,500	24,500	24,500	24,500
Sweden	2001	14,2	muscle meat w skin	Herring (Baltic)	21,000	21,000	21,000	11,000	11,000	11,000	32,000	32,000	32,000
Sweden	2001	13,3	muscle meat w skin	Herring (Baltic)	23,000	23,000	23,000	11,000	11,000	11,000	34,000	34,000	34,000
Sweden	2002	9,5	muscle meat w skin	Herring (Baltic)	1,900	1,900	1,900	2,300	2,200	2,200	4,200	4,100	4,100
Sweden	2002	11,2	muscle meat w skin	Herring (Baltic)	2,000	2,000	2,000	2,300	2,200	2,200	4,300	4,200	4,200

Milk and milk products

					Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound
					(WHO-TEQ) pg/g fat			(WHO-TEQ) pg/g fat			(WHO-TEQ) pg/g fat		
Sample nr	**Year**	**Fat content**	**Food category (milk, milk products)**	**FOOD**	**DIOXIN + FURANS**	**DIOXIN + FURANS**	**DIOXIN+ FURANS**	**DIOXIN – LIKE PCB**	**DIOXIN – LIKE PCB**	**DIOXIN-LIKE PCB**	**TOTAL**	**TOTAL**	**TOTAL**
Finland	2004	3,71	Milk	Milk	0,276	0,166	0,056	0,164	0,155	0,146	0,440	0,321	0,202
Finland	2004	3,97	Milk	Milk	0,168	0,100	0,032	0,102	0,053	0,005	0,270	0,153	0,037
Finland	2004	3,80	Milk	Milk	0,258	0,186	0,113	0,139	0,127	0,115	0,398	0,313	0,229
Finland	1998	3,19	Milk	Milk	0,393	0,265	0,137	0,306	0,301	0,296	0,699	0,566	0,433
Finland	1998	3,19	Milk	Milk	0,419	0,275	0,132	0,295	0,294	0,293	0,714	0,569	0,425
Finland	1998	3,09	Milk	Milk	0,358	0,227	0,096	0,163	0,160	0,157	0,520	0,387	0,253
Finland	1998	3,21	Milk	Milk	0,386	0,247	0,109	0,186	0,184	0,181	0,572	0,431	0,291
Finland	1998	3,22	Milk	Milk	0,372	0,257	0,142	0,154	0,151	0,147	0,527	0,408	0,289
Iceland	2003	81 %	milk product	butter	0,200			0,530			0,730	0,000	0,000
Iceland	2004	81 %	milk product	butter	0,110			0,480			0,590	0,000	0,000
Iceland	2003	26 %	milk product	cheese	0,150			0,330			0,480	0,000	0,000
Iceland	2004	26 %	milk product	cheese	0,140			0,490			0,630	0,000	0,000
Iceland	2003	4 %	milk product	Raw milk	0,140			0,360			0,500	0,000	0,000
Iceland	2003	4 %	milk product	Raw milk	0,130			0,230			0,360	0,000	0,000
Iceland	2003	4 %	milk product	Raw milk	0,180			0,430			0,610	0,000	0,000
Iceland	2004	4 %	milk product	Milk	0,110			0,390			0,500	0,000	0,000
Iceland	2004	4 %	milk product	Milk	0,110			0,360			0,470	0,000	0,000
Iceland	2004	4 %	milk product	Milk	0,110			0,360			0,470	0,000	0,000
Iceland	2003	0,20 %	milk product	Skyr	0,005			0,330			0,335	0,000	0,000
Norway	2004	9,5	milk products	Ice cream	1,582	1,232	0,883	2,104	2,099	2,094	3,686	3,332	2,977
Norway	2004	11	milk products	Ice cream	0,752	0,741	0,731	0,754	0,747	0,740	1,506	1,488	1,470
Norway	2003	82	milk products	Butter	0,297	0,193	0,089	0,990	0,507	0,023	1,287	0,700	0,112
Norway	2004	92,3	milk products	Butter	0,261	0,136	0,011	0,161	0,161	0,160	0,422	0,297	0,171
Norway	2003	27	milk products	Cheese	0,224	0,152	0,079	0,137	0,130	0,123	0,361	0,282	0,202
Norway	2004	25	milk products	Cheese	0,588	0,294	0,000	0,208	0,207	0,206	0,796	0,501	0,206
Norway	2003	27	milk products	Cheese	0,296	0,262	0,228	0,352	0,350	0,347	0,648	0,612	0,575
Norway	2004	26,4	milk products	Cheese	0,497	0,249	0,000	0,228	0,227	0,227	0,725	0,476	0,227
Norway	2004	3,9	milk	Milk	0,569	0,352	0,135	0,442	0,440	0,438	1,011	0,792	0,573
Norway	2002	3,3	milk	Milk	0,249	0,209	0,169	0,780	0,643	0,506	1,606	1,257	0,907
Norway	2002	4,9	milk	Milk	0,194	0,179	0,164	0,429	0,331	0,232	0,623	0,509	0,396
Sweden	2004	3,24	Milk	Milk	1,100	0,930	0,750	0,310	0,310	0,310	1,410	1,240	1,060
Sweden	2004	3,99	Milk	Milk	1,000	0,970	0,930	0,320	0,320	0,320	1,320	1,290	1,250
Sweden	2004	4,11	Milk	Milk	0,580	0,500	0,410	0,250	0,250	0,250	0,830	0,750	0,660
Sweden	2003	4,74	Milk	Milk	0,390	0,240	0,085	0,560	0,560	0,560	0,950	0,800	0,645
Sweden	2003	4,09	Milk	Milk	0,500	0,310	0,110	0,470	0,470	0,470	0,970	0,780	0,580
Sweden	2003	4,29	Milk	Milk	0,540	0,340	0,140	0,680	0,680	0,680	1,220	1,020	0,820

2000-2004	**Denmark**							
TEQ dioxin (PCDD & PCDF)								
Foodstuff	Number of samples	Minimum	Mean	Median	90% fractile	Maximum		
Cows milk	39	0,23	0,47	0,40	0,65	1,55		
Dairy products	16	0,30	0,43	0,42	0,55	0,75		

Egg

Country	Year	Fat content	Food category (Battery eggs, free range eggs)	FOOD	Upper Bound (WHO-TEQ) pg/g fat DIOXIN + FURANS	Medium Bound DIOXIN + FURANS	Lower Bound DIOXIN + FURANS	Upper Bound (WHO-TEQ) pg/g fat DIOXIN – LIKE PCB	Medium Bound DIOXIN – LIKE PCB	Lower Bound DIOXIN LIKE PCB	Upper Bound (WHO-TEQ) pg/g fat TOTAL	Medium Bound TOTAL	Lower Bound TOTAL	
Finland	2004	8,4	free range eggs		0,440	0,331	0,222	0,476	0,476	0,476	0,916	0,807	0,698	
Finland	2004	9,6	free range eggs		1,177	1,128	1,079	1,505	1,505	1,505	2,681	2,632	2,583	
Finland	2004	7,1	free range eggs		1,176	1,118	1,060	1,430	1,430	1,430	2,607	2,549	2,491	
Finland	2003	9,6	free range eggs		0,335	0,194	0,052	0,209	0,207	0,205	0,544	0,400	0,257	
Finland	2003	9,3	cages eggs		0,344	0,207	0,070	0,439	0,439	0,439	0,783	0,646	0,509	
Finland	2003	8,3	cages eggs		0,918	0,807	0,697	0,730	0,730	0,730	1,648	1,538	1,427	
Finland	2000	10,5	cages eggs		0,610	0,531	0,453	0,089	0,078	0,066	0,699	0,609	0,519	
Finland	2000	10,0	cages eggs		0,723	0,655	0,586	0,102	0,093	0,084	0,825	0,747	0,670	
Finland	2000	9,9	barn eggs		1,094	1,022	0,949	0,134	0,125	0,116	1,228	1,147	1,065	
Finland	2000	9,4	barn eggs		1,813	1,750	1,688	0,048	0,034	0,019	1,861	1,784	1,707	
Finland	2000	8,5	free range eggs		1,019	0,950	0,881	0,186	0,180	0,173	1,206	1,130	1,054	
Norway	2002	11	eggs	eggs	0,560	0,518	0,475	0,828	0,762	0,697	1,388	1,280	1,172	
Norway	2002	10	eggs	eggs	0,488	0,458	0,427	0,705	0,603	0,500	1,193	1,060	0,928	
Norway	2003	11	eggs	eggs	0,342	0,342	0,341	0,992	0,648	0,303	1,334	0,989	0,644	
Norway	2004	9,1	eggs	eggs	0,734	0,547	0,359	0,940	0,940	0,939	1,674	1,486	1,298	
Norway	2004	8,2	ecological eggs	eggs	2,001	1,995	1,988	1,891	1,891	1,891	3,893	3,886	3,879	
Norway	2004	9,8	ecological eggs	eggs	0,903	0,700	0,498	1,681	1,681	1,681	2,584	2,381	2,179	
Norway	2004	9,9	ecological eggs	eggs	0,913	0,894	0,875	2,371	2,371	2,371	3,284	3,265	3,245	
Norway	2003	11	ecological eggs	eggs	0,983	0,963	0,943	0,876	0,617	0,357	1,860	1,580	1,300	no-PCB is missing
Norway	2003	11	ecological eggs	eggs	0,726	0,548	0,369	0,804	0,609	0,414	1,530	1,157	0,783	no-PCB is missing
Norway	2003	10	ecological eggs	eggs	0,300	0,261	0,222	0,915	0,629	0,344	1,215	0,890	0,566	no-PCB is missing
Sweden	2004	26,7	indoor free range	egg, yolk	0,420	0,310	0,190	0,120	0,120	0,120	0,540	0,430	0,310	
Sweden	2004	28,87	ecological	egg, yolk	0,690	0,590	0,480	0,700	0,700	0,700	1,390	1,290	1,180	
Sweden	2004	29,74	cage	egg, yolk	0,370	0,280	0,180	0,160	0,160	0,160	0,530	0,440	0,340	
Sweden	2004	25,83	cage	egg, yolk	0,420	0,340	0,250	0,170	0,170	0,170	0,590	0,510	0,420	
Sweden	2004	24,36	indoor free range	egg, yolk	0,450	0,310	0,170	0,150	0,150	0,150	0,600	0,460	0,320	
Sweden	2004	28,33	ecological	egg, yolk	2,440	2,430	2,410	2,290	2,290	2,290	4,730	4,720	4,700	
Sweden	2004	28,41	ecological	egg, yolk	0,410	0,310	0,210	0,130	0,130	0,130	0,540	0,440	0,340	
Sweden	2004	28,44	ecological	egg, yolk	3,200	3,200	3,200	3,000	3,000	3,000	6,200	6,200	6,200	
Sweden	2004	29,15	ecological	egg, yolk	2,800	2,800	2,800	2,400	2,400	2,400	5,200	5,200	5,200	
Sweden	2004	28,56	ecological	egg, yolk	3,300	3,300	3,300	2,800	2,800	2,800	6,100	6,100	6,100	
Sweden	2003	29,92	cage	egg, yolk	0,570	0,300	0,030	0,250	0,250	0,250	0,820	0,550	0,280	
Sweden	2003	27,1	ecological	egg, yolk	0,590	0,320	0,041	0,130	0,130	0,120	0,720	0,450	0,161	
Sweden	2003	27,58	ecological	egg, yolk	2,900	2,900	2,800	2,700	2,700	2,700	5,600	5,600	5,500	
Sweden	2003	27,23	ecological	egg, yolk	3,100	3,100	3,100	2,400	2,400	2,400	5,500	5,500	5,500	
Sweden	2003	30,03	ecological	egg, yolk	2,200	2,200	2,200	2,400	2,400	2,400	4,600	4,600	4,600	
Sweden	2003	28,63	cage	egg, yolk	0,500	0,270	0,034	0,170	0,170	0,160	0,670	0,440	0,194	
Sweden	2003	28,58	cage	egg, yolk	0,500	0,270	0,045	0,180	0,180	0,180	0,680	0,450	0,225	
Sweden	2003	27,87	ecological	egg, yolk	1,500	1,300	1,100	1,900	1,900	1,900	3,400	3,200	3,000	

Denmark 2000-2004
TEQ total (dioxin & PCB)

Foodstuff	Number of samples	Minimum	Mean	Median	90% fractile	Maximum
Hen eggs	43	0,26	1,28	0,76	3,05	4,60

Vegetable oil

Country	Year	Fat content	(fat ruminants, fat poultry/game, fat pigs, mixed animal fat, veg.	FOOD	Upper Bound (WHO-TEQ) pg/g fat DIOXIN + FURANS	Medium Bound DIOXIN + FURANS	Lower Bound DIOXIN+ FURANS	Upper Bound (WHO-TEQ) pg/g fat DIOXIN – LIKE PCB	Medium Bound DIOXIN – LIKE PCB	Lower Bound DIOXIN- LIKE PCB	Upper Bound (WHO-TEQ) pg/g fat TOTAL	Medium Bound TOTAL	Lower Bound TOTAL	
Finland	2004	100		vegetable oil	0,156	0,078	0	0,034	0,017	0	0,190	0,095	0	
Finland	2004	100		cooking oil	0,147	0,074	0,00079	0,034	0,017	0	0,181	0,091	0	
Finland	2003	100		rapeseed oil	0,171	0,085	0	0,010	0,0052	0	0,181	0,091	0	
Finland	2003	100		rapeseed oil	0,209	0,122	0,035	0,013	0,0064	0	0,221	0,128	0,035	
Finland	2003	100		rapeseed oil	0,195	0,097	0	0,013	0,0064	0,000024	0,207	0,104	0,000024	
Finland	2004	66	Margarine	margarine	0,170	0,086	0,0026	0,031	0,016	0	0,201	0,102	0	
Finland	2004	38	Margarine	margarine	0,144	0,072	0,00027	0,033	0,017	0	0,177	0,089	0	
Norway	2003	100	vegetable oil	Soy oil	0,272	0,148	0,023	0,027	0,013	0,000	0,298	0,161	0,023	No-PCB missing
Norway	2003	100	vegetable oil	Sunflower oil	0,128	0,064	0,000	0,829	0,414	0,000	0,956	0,478	0,000	No-PCB missing
Norway	2004	100	vegetable oil	Sunflower oil	0,588	0,298	0,007	0,034	0,018	0,002	0,622	0,316	0,009	
Norway	2004	100	vegetable oil	Olive oil	0,504	0,252	0,000	0,027	0,014	0,001	0,531	0,266	0,001	
Norway	2003	60	Omea margarine	Omega margarine	0,221	0,112	0,003	1,018	1,012	1,006	1,239	1,124	1,010	

Denmark	of	Minimum	Mean	Median	fractile	Maximum
Vegetable oil	6	0,05	0,11	0,08		0,24

Marine oil

					Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound	Upper Bound	Medium Bound	Lower Bound
					(WHO-TEQ) pg/g fat			(WHO-TEQ) pg/g fat			(WHO-TEQ) pg/g fat		
Country	**Year**	**Fat content**	**Food category marine oil)**	**FOOD**	**DIOXIN + FURANS**	**DIOXIN + FURANS**	**DIOXIN + FURANS**	**DIOXIN – LIKE PCB**	**DIOXIN – LIKE PCB**	**DIOXIN-LIKE PCB**	**TOTAL**	**TOTAL**	**TOTAL**
Iceland	2004		Marine oil	cod liver oil	0.230						0.230		
Iceland	2004		Marine oil	cod liver oil	0.120			1.240			1.360		
Iceland	2004		Marine oil	cod liver oil	0.210			9.400			9.610		
Iceland	2004		Marine oil	cod liver oil	0.300						0.300		
Iceland	2004		Marine oil	cod liver oil	0.200			1.390			1.590		
Iceland	2004		Marine oil	cod liver oil	0.180						0.180		
Iceland	2004		Marine oil	cod liver oil	0.180						0.180		
Iceland	2004		Marine oil	omega 3 fish oil	0.190						0.190		
Iceland	2004		Marine oil	omega 3 fish oil	0.200						0.200		
Iceland	2004		Marine oil	omega 3 fish oil	0.170						0.170		
Iceland	2004		Marine oil	omega 3 fish oil	0.140						0.140		
Iceland	2004		Marine oil	omega 3 fish oil	0.280						0.280		
Iceland	2004		Marine oil	omega 3 fish oil	0.160						0.160		
Iceland	2004		Marine oil	omega 3 fish oil	0.170						0.170		
Iceland	2004		Marine oil	omega 3 fish oil	0.170						0.170		
Iceland	2004		Marine oil	omega 3 fish oil	0.190						0.190		
Iceland	2004		Marine oil	omega 3 fish oil	0.140						0.140		
Iceland	2004		Marine oil	capelin oil	0.140						0.140		
Iceland	2004		Marine oil	tuna oil	0.240			1.130			1.370		
Iceland	2004		Marine oil	shark liver oil	0.340			1.240			1.580		
Iceland	2004		Marine oil	squalene	0.230			1.820			2.050		
Norway	2003	100	marine oil	Cod liver oil (for human consumptior	0.186	0.146	0.106	0.642	0.642	0.642	0.828	0.788	0.748
Norway	2003	100	marine oil	Cod liver oil (for human consumptior	0.466	0.431	0.397	0.376	0.376	0.376	0.841	0.807	0.773
Norway	2003	100	marine oil	Cod liver oil (for human consumptior	0.114	0.068	0.022	0.372	0.372	0.372	0.486	0.440	0.394
Norway	2003	100	marine oil	Fish oil (for human consumption)	0.174	0.128	0.082	1.925	1.925	1.925	2.099	2.053	2.007
Norway	2003	100	marine oil	Fish oil (for human consumption)	0.234	0.174	0.113	1.869	1.869	1.869	2.104	2.043	1.983
Norway	2003	100	marine oil	Fish oil (for human consumption)	0.156	0.092	0.029	0.071	0.069	0.068	0.226	0.162	0.097
Norway	2003	100	marine oil	Fish oil (for human consumption)	1.329	1.272	1.215	7.739	7.739	7.739	9.067	9.011	8.954
Norway	2003	100	marine oil	Salmon oil (for human consumption)	0.344	0.309	0.274	0.608	0.607	0.605	0.953	0.916	0.879
Norway	2003	100	marine oil	Seal oil (for human consumption)	0.490	0.462	0.434	5.968	5.968	5.968	6.458	6.430	6.401
Norway	2003	100	marine oil	Shark liver oil (for human consumpti	0.855	0.820	0.785	3.561	3.561	3.561	4.416	4.381	4.345
Norway	2004	100	marine oil		0.070	0.030	0.000	1.620	1.620	1.620	1.690	1.650	1.620
Norway	2004	100	marine oil		0.120	0.090	0.060	1.110	1.110	1.110	1.230	1.200	1.170
Norway	2004	100	marine oil		0.090	0.050	0.010	1.810	1.810	1.810	1.900	1.860	1.820
Norway	2004	100	marine oil		0.060	0.030	0.000	0.720	0.720	0.720	0.780	0.750	0.720
Norway	2004	100	marine oil		0.330	0.260	0.200	0.220	0.210	0.210	0.550	0.470	0.410
Norway	2004	100	marine oil		0.450	0.400	0.350	6.450	6.450	6.450	6.900	6.850	6.800
Norway	2004	100	marine oil		0.060	0.030	0.000	0.910	0.910	0.910	0.970	0.940	0.910
Norway	2004	100	marine oil		0.230	0.120	0.010	0.080	0.080	0.080	0.310	0.200	0.090
Norway	2004	100	marine oil		0.300	0.200	0.110	0.650	0.650	0.650	0.950	0.850	0.760
Norway	2004	100	marine oil		0.160	0.140	0.120	1.390	1.390	1.390	1.550	1.530	1.510
Sweden	2003	100	Marine oil	fish oil	0.720	0.430	0.140	0.130	0.130	0.120	0.850	0.560	0.260
Sweden	2003	100	Marine oil	cod liver oil	2.100	2.000	2.000	6.300	6.300	6.300	8.400	8.300	8.300
Sweden	2003	100	Marine oil	fish oil	0.700	0.420	0.140	2.000	2.000	2.000	2.700	2.420	2.140
Sweden	2003	100	Marine oil	fish and veg oil	0.680	0.410	0.150	0.260	0.260	0.260	0.940	0.670	0.410
Sweden	2003	100	Marine oil	fish oil	0.690	0.390	0.090	1.600	1.600	1.600	2.290	1.990	1.690
Sweden	2003	93.8	Marine oil	fish oil	0.970	0.720	0.470	2.100	2.100	2.100	3.070	2.820	2.570
Sweden	2003	100	Marine oil	fish oil	0.660	0.380	0.090	0.071	0.065	0.059	0.731	0.445	0.149
Sweden	2003	100	Marine oil	fish oil	0.860	0.620	0.390	0.074	0.068	0.061	0.934	0.688	0.451
Sweden	2003	100	Marine oil	fish oil	0.280	0.160	0.060	0.080	0.080	0.080	0.360	0.240	0.140
Sweden	2003	100	Marine oil	fish oil	0.750	0.460	0.170	0.061	0.055	0.049	0.811	0.515	0.219
Sweden	2003	91.4	Marine oil	fish oil	1.600	1.400	1.100	15.000	15.000	15.000	16.600	16.400	16.100

Abbreviations

ALARA	As low as reasonably achievable
BAT	Best available technology
BW (bw)	Body weight
EFSA	European Food Safety Authority
EU	European Union
DL-PCBs	Dioxin-like PCBs
JECFA	Joint Expert Committee on Food Additives and Contaminants
LB	Lower bound
LOD	Limit of Detection
LOQ	Limit of Quantification
MB	Medium bound
ML	Maximum level
MS	Mass spectrometry
NMR	Nordic Council of Ministers
NNT	Joint Nordic Working Group on Food Toxicology
PCB	Polychlorinated biphenyl
PCDD	Polychlorinated dibenzo-*p*-dioxin
PCDF	Polychlorinated dibenzofuran
SCF	Scientific Committee on Food
TEF	Toxic Equivalency Factor
TEQ	Toxic Equivalents of 2,3,7,8-TCDD
TWI	Tolerable weekly intake
UB	Upper bound
WHO	World Health Organization