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Report of experts participating in Task 3.2.5

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Assessment of dietary intake of dioxins and related PCBs by the population of EU Member States

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Foreword

Scientific Co-operation on Questions Relating to Food

The scope and limitations of this report

Council Directive 93/5/EEC “on the assistance to the Commission and co-operation by the Member States in the scientific examination of questions relating to food” was adopted on 25 February 1993. It lays down a procedure whereby Member States of the European Union can focus their scientific resources in a co-ordinated manner on problems facing the Commission in the area of food. The individual tasks to be undertaken are agreed in consultation with the Member States who also determine in which tasks they wish to participate and the extent of their participation. Directive 93/5/EEC requires that an inventory of tasks be published at least every six months. This publication, which takes the form of a Commission Decision, specifies the participating Member States, the Member State that provides co-ordination and the time limit for completion of the task.

In general terms, tasks undertaken under scientific co-operation are designed to provide a factual basis to support a Commission action in the area of food. Such support may involve the provision of information as may be required, for example, by the Scientific Committee for Food (SCF) for its evaluation and advisory work or by the Commission’s own services for the development of proposals for Community action.

The tasks themselves are carried out by a group of experts nominated by the National Authorities responsible for Scientific Co-operation in the Member States (the National Designated Authorities).

Although the scope of reports generated under the scientific co-operation procedure is restricted to essentially factual matters, presentation of inherently complex information without some reasoned interpretation and summary by specialists would be of limited value and even open to misleading conclusions. Such interpretation necessarily involves a degree of expert judgement.

It is therefore stressed that the interpretation and views expressed in this report are not necessarily those of the participating Member States or those of the European Commission.

GLOSSARY

2,4,5-T	2,4,5-trichlorophenoxy acetic acid
2,3,7,8-TCDD	2,3,7,8-tetrachloro dibenzo-p-dioxin
AQA	Analytical Quality Assurance
BCR	Bureau Communautaire de Reference Community Bureau of Reference
bw	Body weight
CCFAC	Codex Committee on Food Additives and Contaminants
CEN	Commission d'Europeenne de Normalisation (European Committee for Standardisation)
ECD	Electron capture detector
ECEH	European Centre for Environment and Health
EPA	US Environmental Protection Agency
EU-SM&T	Standard, Measurement and Testing programme of the EU
GC	Gas chromatography
GPC	Gel permeation chromatography
HPLC	High performance liquid chromatography
HRMS	High resolution mass spectrometry
IARC	International Agency for Research on Cancer
ICES	International Council for Exploration of the Sea
ICES 7	In this report referring to the selection of PCB congeners with IUPAC numbers 28, 52, 101, 118, 138, 153 and 180
IPCS	International Programme on Chemical Safety
I-TEF	International Toxic Equivalency Factor (international harmonized scheme of TEFs for PCDDs and PCDFs as published by NATO/CCMS in 1988)
I-TEQ	TEQ value calculated using the I-TEFs for PCDDs and PCDFs (NATO/CCMS, 1988)
IUPAC	International Union of Pure and Applied Chemistry
LOD	Limit of Determination
MS	Mass spectrometry
NATO/CCMS	North Atlantic Treaty Organization, Committee on the Challenges of Modern Society
PCB	Polychlorinated biphenyl

PCB-TEQ	TEQ contribution of dioxin-like PCBs calculated using the TEFs as published by Ahlborg et al. (1994)
PCDD	Polychlorinated dibenzo-*p*-dioxin
PCDF	Polychlorinated dibenzofuran
PCT	Polychlorinated terphenyl
PCQ	Polychlorinated quaterphenyl
RSD	Relative standard deviation
SCF	Scientific Committee on Food
SCOOP	Scientific Co-operation on Questions relating to Food (Directive 93/5/EEC)
SIR	Selected ion recording (mode of mass spectrometry)
TCDD	Tetrachloro dibenzo-*p*-dioxin
TDI	Tolerable daily intake
TDS	Total diet study
TEF	Toxic Equivalency Factor
TEQ	Toxic equivalents of 2,3,7,8-TCDD
WHO	World Health Organization
WHO-TEQ	Total TEQ value based on TEQ contributions of PCDDs, PCDFs and PCBs calculated using the TEFs as derived by a WHO expert group in 1997 and published by Van den Berg et al. (1998)

PARTICIPANTS

All EU Member States and EFTA States were invited to participate in this project. The following institutes and persons were nominated by their national authorities to co-ordinate the collection of the data on behalf of their countries:

Country	Participating Institute
BELGIUM	Federaal Ministerie van Sociale Zaken, Volksgezondheid en Leefmilieu - Algemene Eetwareninspectie C. VINKX Scientific Institute of Public Health - Louis Pasteur S. SREBRNIK
DENMARK	Danish Veterinary and Food Administration T. CEDERBERG
FINLAND	National Food Administration A. HALLIKAINEN National Public Health Institute H. KIVIRANTA
FRANCE	Institut National Agronomique Paris-Grignon (INAP-G) J.-C. LEBLANC INRA, Scientific Directorate on Human Nutrition and Food Safety P. VERGER Centre National d’Études et de Recommendations sur la Nutrition et l’Alimentation (CNERNA) F. DECLOITRE
GERMANY	Bundesinstitut für gesundheitlichen Verbraucherschutz und Veterinärmedizin (BgVV) B. VIETH and W. MATHAR

ITALY	Istituto Superiore di Sanitá E. DE FELIP and A. PICCIOLI BOCCA
NETHERLANDS	National Institute of Public Health and the Environment (RIVM) Laboratory for Organic-analytical Chemistry A.K.D. LIEM, S.M. GORT and R. HOOGERBRUGGE
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EXECUTIVE SUMMARY

This report describes the results of Scientific Co-operation (SCOOP) Task 3.2.5[1]. The objective of this specific task was to provide the European Commission with information on dietary exposure to PCDDs, PCDFs and dioxin-like PCBs in participating countries. The project was co-ordinated by the National Institute of Public Health and the Environment (RIVM) in Bilthoven, the Netherlands, and the National Food Administration in Uppsala, Sweden. Ten countries, i.e. Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Sweden and United Kingdom, delivered available data on the occurrence of PCDDs, PCDFs and dioxin-like PCBs in food products and human milk. Wherever available or possible, data on the consumption of these foods and data on the dietary exposure of the general population to these compounds were provided. The data were reported in a given format and relevant supporting information was collected on the quality of the data together with an evaluation of whether the data were considered to be representative of the country and so relevant for use in calculating dietary intake estimates. There were large differences in the amount, detail and quality of the data from the participating countries. The judgement of whether the occurrence data were representative or not, and so useful for intake estimations, was done by the participating countries for their own data.

Occurrence data

The SCOOP task resulted in a comprehensive database with information on concentrations of PCDDs, PCDFs and/or dioxin-like PCBs in samples of food products and human milk. Samples were taken from various sites, including rural and industrial sites, and were collected in different years covering the period 1982 - 1999. The data resulting from some studies were considered representative for the country and suitable for use in intake estimates.

It is widely known that the determination of PCDDs, PCDFs and dioxin-like PCBs requires special expertise and sophisticated instrumentation. Consequently, broad field surveys based on a large number of samples are rare. Nevertheless, the current database can be considered relatively complete for PCDDs and PCDFs, but rather incomplete for dioxin-like PCBs.

[1] Commission Decision 98/177/EC of 19 February 1998 amending Commission Decision 94/652/EC establishing the inventory and distribution of tasks to be undertaken within the framework of cooperation by Member States in the scientific examination of questions relating to food.

The current database shows national average concentrations[2] of PCDDs and PCDFs in eggs, fats and oils, meat (products) and milk (products) of generally less than 1 up to 2-3 picogram (pg) I-TEQ[3] per gram (g) of fat. PCDD and PCDF levels in fish ranged between 0.25 and 10-20 pg I-TEQ/g on product basis. Concentrations in fruits, vegetables and cereals were found to be relatively low, and were generally close to the limits of determination. Concentrations in meat (products) and fish (products) seem to vary between the various sample types (e.g. higher levels on a fat basis in liver than in adipose) and between the different animal species (e.g. lower concentrations on a fat basis in pork than in beef, poultry or mutton). A decreasing trend in the concentration of PCDDs and PCDFs in foods has been reported for a few countries. This decline is most likely for consumer milk and some types of meat. The available information is insufficient and incomplete to draw a general conclusion on temporal trends for other types of foods.

The information, although limited with respect to concentrations of dioxin-like PCBs, indicates average TEQ[4] contributions of one to two times the TEQ contribution of PCDDs and PCDFs. It has been noted that some PCB congeners (such as PCBs 126 and 118) may contribute more significantly to the total TEQ content of foods than do the PCDDs and PCDFs. This situation results both from the relatively high concentrations and, in some cases, from the relatively high TEF value for some of the dioxin-like PCB congeners compared to other PCB congeners.

A considerable amount of data exists for concentrations of PCDDs and PCDFs in human milk. For the period before 1995, the national averages ranged between 10 and 34 pg I-TEQ/g fat. For the period 1995-1999 the national average concentrations ranged between 8 and 16 pg I-TEQ/g fat, for some countries clearly indicating a downward trend.

The database for human milk is not sufficiently complete to draw a firm conclusion about the TEQ contribution of dioxin-like PCBs. The few studies reported have been performed in the period 1990-1994 and indicate a mean PCB-TEQ concentration varying from comparable to three times the I-TEQ contribution of PCDDs and PCDFs (7-29 pg PCB-TEQ/g fat).

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[2] Most concentrations represent upper bound estimates assuming nondetects equal the limits of determination (see notes in Annex 3).

[3] TEQ of PCDDs and PCDFs calculated using International TEFs according to NATO/CCMS (1988).

[4] TEQ of dioxin-like PCBs calculated using PCB-TEFs according to Ahlborg et al. (1994).

Food consumption data

The consumption data from the participating countries are generally produced from studies performed rather recently. The survey methods differ, including consumption record studies (2-28 days) as well as 24 h recall, household budget and food frequency questionnaire studies. The study populations were generally adults (from teenagers to elderly) but UK and Germany have also studied separate groups of consumers, including breast-fed infants, toddlers, schoolchildren and adults. The food consumption data reveals variations between countries in consumption of different food groups, a mirror of the country-specific food traditions and habits.

Dietary intakes

The estimates of dietary intakes of dioxins and related PCBs in this report are based on a limited amount of data and there are uncertainties related to the methods used to estimate dietary intakes. It was decided on basis of the known limitations in amount and quality of the data to concentrate on an estimate of the mean dietary intake of dioxins and related PCBs by combination of mean concentrations with average consumption of food groups. In addition, some countries also submitted data on the 95-percentile (or 97.5-percentile) of the dietary intake based on mean concentrations and high consumption of food groups.

Eight countries gave an estimate of mean dietary intake for an average adult person based on dioxin occurrence in food and food consumption data. For the period after 1995, the average dietary intakes of PCDDs and PCDFs ranged between 29 and 97 pg I-TEQ/day, which on a body weight basis would correspond to approximately 0.4-1.5 pg I-TEQ/kg bw/day. For surveys based on chemical analyses of foods collected in the 1970s and 1980s, intakes were estimated to be higher, ranging from 127 to 314 pg I-TEQ/day (approx. 1.7-5.2 pg I-TEQ/kg bw/day). The 95-percentile (or 97.5-percentile) intake, based on data from the Netherlands and United Kingdom was 2-3 times the mean intake.

For the TEQ contribution of dioxin-like PCBs, the average intakes were between 48 and 110 pg PCB-TEQ/day (approx. 0.8-1.8 pg PCB-TEQ/kg bw/day). In studies investigating both dietary intakes of PCDDs/PCDFs and PCBs, the TEQ contribution of dioxin-like PCBs was estimated to be almost equal (e.g. Finland, Netherlands, Sweden, United Kingdom) to approximately four times (Norway) the TEQ contribution of the PCDDs and PCDFs.

The main contributors to the average daily intake of dioxins (I-TEQ) in the participating countries are milk and dairy products (contributions ranged from 16-39%), meat and meat products (6-32%)

and fish and fish products (2-63%). Other products, mainly of plant origin such as vegetables, cereals, contributed 6-45% in those countries for which data were available. In this regard, it should be noted that the relative contribution of the food groups to the total intake of I-TEQ differed from country to country. These differences may result from different food consumption habits in the participating countries. On the other hand, other factors may also be involved. These include factors related to the applied sampling strategy (e.g. differences in the coverage of products collected to represent the whole food group) and the large variations in concentrations of dioxin related substances in some of the food groups (e.g. vegetables and fruits, eggs and fish).

In most countries, young children will have a higher intake per kg body weight than adults. This is especially true during the breast-feeding period. On a body weight basis, the intake of breast-fed infants has been estimated to be 1 to 2 orders of magnitude higher than the average adult intake. For high level consumers of one or more of the dioxin-containing products the contribution from these products could be of significant importance for the total dietary intake of dioxins and dioxin-like PCBs.

A few countries (i.e. Finland, Germany, Netherlands, Sweden and the United Kingdom) reported sufficient data for the establishment of time trends. These data clearly reveal that the exposure of the general population to dioxins is declining. For Germany, Finland, Netherlands and Sweden this decline is also noted for concentrations in human milk.

Recommendations

The participants in this SCOOP task recommend to repeat this collation of occurrence and food consumption data every 5 or 10 years because it is extremely valuable to compare and to follow temporal trends in the exposure of the populations of different European countries to dioxin and related compounds. In this regard, European countries other than those that took part in SCOOP Task 3.2.5 are strongly encouraged to add their information into the established SCOOP database, and to take part in any future EU scale dioxin project.

Future studies should not only focus on national average concentrations but also on the distribution of these concentrations. Wherever possible, the sources most likely to lead to the occurrence of these compounds should be identified. In order to allow these type of investigations, analytical data should become available on a congener specific basis rather than on a TEQ basis only. In order to improve the comparability of information on dioxin-like PCBs, it is strongly recommended to include the whole selection of dioxin-like PCB congeners as recommended by WHO (Van den Berg et al., 1998). Furthermore, interlaboratory comparison studies should be conducted in EU or other international framework in order to be able to assess the between-lab comparability of the chemical information included in the database.

1 INTRODUCTION

This project has been carried out at the request of the Commission of the European Communities as a SCOOP project. The task was co-ordinated by the Dutch and Swedish authorities. The objectives of the specific task were to provide a scientific basis for the evaluation and management of risks to public health arising from exposure to dioxin and related compounds as contaminants in food, including human milk, in all participating countries.

Emphasis was put on the occurrence of PCDDs, PCDFs and related PCBs in foods, and the resulting dietary exposure of the general population. The PCBs were those with dioxin-like toxicity, i.e. PCB congeners with the same mechanism of action and resulting in biochemical and toxic responses in animals and humans comparable to that of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TCDD). The present selection of dioxin-like PCBs includes the 3,3',4,4'-chlorine substituted non-ortho (planar) PCB congeners, and the mono-ortho PCB congeners with a planar or nearly planar conformation, and a geometrical size similar to 2,3,7,8-substituted dioxins and furans. As the toxicity of the different substances varies, toxic equivalency factors (TEFs) were used to express concentrations and exposures in toxic equivalents of 2,3,7,8-TCDD (TEQ).

It should be noted that the compilation of data on the human exposure to dioxins and related compounds has been the subject of various international studies conducted in the past few years. For instance, a very informative document containing an extensive compilation of data on concentrations of PCDDs and PCDFs in foods and human milk, and resulting intakes for the general population, has been published in Volume 69 of IARC’s Monographs on the Evaluation of Carcinogenic Risks to Humans (IARC, 1997). In October 1999, AEA Technology presented a comprehensive report in the framework of a project entitled “Compilation of EU Dioxin Exposure and Health Data” (AEA Technology, 1999). A significant part of the SCOOP database will compile the same information as published in the above mentioned reports. However, it will also contain more recent material resulting from studies conducted until the end of 1999. In addition, it will contain information on dioxin-like PCBs, which were not taken into consideration in the other reports.

Ten countries (Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Sweden and United Kingdom) announced an interest to take part in this task. The task was started in June 1998, and has been coordinated by the National Institute of Public Health and the Environment (RIVM) in Bilthoven, the Netherlands, and the National Food Administration (NFA) in Uppsala, Sweden. Four meetings with all the delegates participating in this project and several preparatory meetings took place to elaborate the present report.

2 BACKGROUND

2.1 PCDDs and PCDFs

The term ‘dioxins’ refers to a group of polychlorinated, planar aromatic compounds with similar structures, chemical and physical properties. This group of compounds consists of 75 dibenzo-*p*-dioxins (PCDDs) and 135 dibenzofurans (PCDFs), of which 2,3,7,8-TCDD is the most toxic and most studied congener. Dioxins are lipophilic compounds that bind to sediment and organic matter in the environment and tend to be absorbed in animal and human fatty tissue. The seventeen 2,3,7,8-chlorine substituted PCDD and PCDF congeners in particular are extremely resistant towards chemical and biological degradation processes and, consequently, persist in the environment and accumulate in the food chain.

Dioxins are not produced commercially and have no applications, other than for preparation of analytical standards and research materials. They are formed during combustion processes in, for example, waste incinerators or as unwanted by-products of industrial processes. Evaporation from chlorophenol wood preservatives, emission by sinter industries, the use of defoliants, the preparation of herbicides, traffic and bleaching of paper pulp using chlorine are also known to contribute to environmental contamination with dioxins. The incineration of municipal, industrial and hazardous waste is generally considered as the major contributor of dioxin emissions into air. At the end of 1980s, various countries took a number of regulatory measures to reduce the emissions of dioxins. Since then, the environmental release of dioxin-like compounds has been reported to have decreased as a result of changes in industrial practices and because of the ban on the production or use of products containing these compounds. Several studies on PCDDs and PCDFs in sediment cores have shown that highest dioxin levels occurred in the 1960s and 1970s, and that a gradual decrease in these levels can be observed since the 1980s (Beurskens et al., 1991; Rappe, 1992; Basler, 1994; Liem and Van Zorge, 1995).

Most of the dioxins enter the environment by emission to air, due to which deposition may occur both near and far away from the source. In industrialized countries, dioxins have been identified in almost all environmental compartments. Relatively little is known about the fate of dioxins released into the environment, i.e. transport, distribution and transformation. Based on the available occurrence data, evidence has grown that environmental residence times are in the order of many years (WHO/IPCS, 1989; Fiedler et al., 1990; IARC, 1997; Liem and Theelen, 1997).

A broad spectrum of toxic and biochemical effects has been reported for PCDDs and PCDFs in laboratory animals. For laboratory animals the most sensitive endpoints are endometriosis, developmental neurobehavioral (cognitive) effects, developmental reproductive (sperm counts, female urogenital malformations) effects and immunotoxic effects. TCDD has been shown to be carcinogenic in several species at multiple sites. Short-term studies, however, have shown a lack of direct DNA-damaging effects, illustrating that TCDD is not an initiator but a promoter of carcinogenesis.

A few well-known accidents and incidents revealed human health problems probably related to exposure to high levels of dioxin related compounds. In general, co-exposure to dioxins, PCBs and possible other contaminants can not be excluded in these accidents. Therefore, the observed effects can not be exclusively associated with exposure to either dioxin or PCB congeners. Cloracne correlates consistently with high exposure of humans to TCDD.

Epidemiological evidence from the most highly 2,3,7,8-TCDD exposed cohorts studied produces the strongest evidence of increased risks for all cancers combined, along with less strong evidence of increased risks for cancers of particular sites. Such associations have become apparent after a latency period of more than 5 years in accidentally highly exposed people in Seveso or after more than 20 years in occupationally exposed people.

Non-cancer endpoints were evaluated among groups exposed to dioxins, dioxin-like and non-dioxin-like polychlorinated aromatic compounds with a variety of exposure scenarios. A WHO-ECEH and IPCS consultation has observed that among children exposed in utero to background levels, subtle endocrine and developmental alterations may occur that could persist for long times. Of the many effects evaluated in highly exposed adult populations, many were transient effects disappearing after the end of the high exposure (WHO, 1999; CCFAC, 2000).

2.2 Dioxin related compounds

In the last few years the extent to which other compounds structurally related to the group of 2,3,7,8-substituted PCDD and PCDF congeners exert biochemical and toxic responses similar to that of 2,3,7,8-TCDD has been repeatedly questioned. It is obvious that a number of different classes of halogenated compounds might belong to this group (also referred to as 'dioxin related' or 'dioxin-like' compounds), but the strongest evidence has been shown for some of the polychlorinated biphenyls with a planar or nearly planar conformation.

2.2.1 PCBs

The group of polychlorinated biphenyls (PCBs) consists of 209 congeners of which 130 are likely to occur in commercial products. PCBs have been produced commercially under various product names such as Aroclor, Clophen and Kanechlor. These products are PCB mixtures containing both coplanar and non-planar congeners and have been used in various technical applications. The marketing and use of PCBs has been very restricted in the EU through Directive 85/467/EC, and some European countries, as Sweden, had even banned the use of PCBs as early as 1973. An international convention, the POPs (Persistent Organic Pollutants) Convention, currently in negotiation, aims to ban the production and use of PCBs worldwide. Today, PCBs are widely spread. They are largely present in transformers and capacitors where they were used as dielectric fluids, but also in building material, carbon less copy paper, lubricants, surface coatings, adhesives, plasticizers, and inks among other uses. Council Directive 96/59/EC of 16 September 1996 on the disposal of PCBs and polychlorinated terphenyls (PCTs) lays down provisions for the decontamination and/or disposal of equipment containing these chemicals. According to this Directive, Member States have to establish inventories of equipment with more than 5 litres of PCB/PCTs and have to submit plans for the decontamination and/or disposal of equipment containing PCBs to the Commission by September 1999. Since most Member States have not fulfilled their duties yet, the Commission is examining whether infringement procedures should be started against those Member States. Although immediate decontamination and/or disposal of contaminated equipment is aimed at, the deadline for the decontamination/disposal of equipment containing more than 5 litres of PCBs is 2010. However, some Member States, especially northern countries, have established earlier deadlines at national level.

The earliest symptoms of high PCB exposure are reversible dermal and ocular effects. Respiratory complaints could be persistent for some years. Recent data indicate that fetal exposure to PCBs may be associated with cognitive deficits in infants and young children. These effects were measured in infants from mothers exposed to relatively high levels of PCBs due to a prolonged consumption of contaminated fish. In addition to the cognitive effects, an increase in tumour incidence and neurological, endocrine, hepatotoxic and immunotoxic effects were observed in populations in Yusho, Japan (1969) and Yu-Cheng, Taiwan (1979) that were accidentally exposed to rice oil contaminated with high levels of PCBs, PCDFs and polychlorinated quaterphenyls (PCQs).

For PCBs, almost all the available epidemiological data originate from studies in workers occupationally exposed to PCBs. The studies reported thus far do not support a causal association for PCBs and human cancer. Study limitations and inconsistent findings among studies cause inconclusive results. Based on animal carcinogenicity data, both IARC and US-EPA classified PCBs as probably carcinogenic to humans (CCFAC, 2000).

In summary, there are many biological and toxic effects reported for the group of PCBs. Some PCB congeners may adopt a planar 'dioxin-like' chemical structure and have indeed been found to resemble TCDD in its biochemical and toxicological properties. Other PCBs elicit effects that are probably not or only partly related to a dioxin-like mechanism of action (Van den Berg et al., 1998).

2.2.2 Other compounds

Besides PCBs, other structurally related compounds have been demonstrated to elicit dioxin-like activity. These include any or all of the following classes of polyhalogenated compounds: benzenes, naphthalenes, diphenyl ethers, diphenyl toluenes, phenoxy anisoles, biphenyl anisoles, xanthenes, xanthones, anthracenes, fluorenes, dihydroanthracenes, biphenyl methanes, phenylxylylethanes, dibenzothiophenes, quaterphenyls, quaterphenyl ethers, and biphenylenes. However, due to the lack of information on environmental occurrence and the limited data to compare their toxicity relative to that of 2,3,7,8-TCDD, no international agreement has yet been reached to derive TEFs for compounds other than the group of dioxin-like PCBs (Van den Berg et al., 1998).

2.3 Background exposure

For the general human population, the major pathway of exposure to dioxins and PCBs is food. Over 90 percent of human exposure is estimated to occur through the diet, with foods of animal origin usually being the predominant sources. Contamination of food is primarily caused by deposition of emissions of various sources (e.g. waste incineration, production of chemicals, metal industry) and a subsequent accumulation in the food chain in which they are particularly associated with fat. Other sources may include contaminated feed, improper application of sewage sludge, flooding of pastures, waste effluents and certain types of food processing (Fürst et al., 1992; Malisch, 1998; McLachlan and Riechter, 1998; Rappe et al., 1998; Bernard et al., 1999).

Within the general population, some sub-populations may be exposed to higher amounts of dioxins and PCBs as a result of particular consumption habits (e.g. nursing infants, high level consumers of fish from contaminated areas). The high exposures of nursing infants during periods of breastfeeding has led to a worldwide concern and to many studies to evaluate the presence of dioxin related compounds in human milk in different countries (WHO/ECEH, 1996).

2.4 Accidental and occupational exposure

As mentioned before, several accidents have been reported to cause excess human exposure to dioxins and PCBs. Well-known examples of accidental exposure of the local population to PCDDs, PCDFs and PCBs include the explosion of the 2,4,5-trichlorophenol factory at Seveso, and fires in PCB filled electrical equipment. High exposure may also be caused by food items accidentally contaminated. Known examples are the extremely high contamination of edible rice oils, such as the Yusho (1968) and Yu-Cheng (1978) food poisoning episodes.

In the last few years, a few cases occurred of dioxin (and PCB) contamination of animal feeds and foods. This includes the dioxin contamination of Brazilian citrus pulp pellets (an ingredient for feeding stuffs) in 1997-1998 (Malisch, 1998), the contamination of animal feeds with PCBs and dioxins in Belgium in the spring of 1999 (Bernard et al., 1999), and the dioxin contamination of kaolinitic clay (a feed additive) from some mines in the USA (Rappe, 1998) and Germany (Jobst, 1999). In each of these cases preventive measures were taken to avoid a further distribution of contaminated products and to protect the consumer against foods with elevated levels of dioxins and PCBs.

Occupational activities, such as at waste incineration plants or during the manufacture of chlorinated compounds (e.g. chlorophenols, chlorophenoxy herbicides) may also result in elevated exposures (WHO/IPCS, 1989, IARC, 1997). This is not only true for the chemical(s) produced but also for impurities formed during the manufacture like 2,3,7,8-TCDD as by-product in formulations of 2,4,5-T (2,4,5-trichlorophenoxy acetic acid). It is important to note that for occupational exposure to chemicals other pathways such as exposure through inhalation of air may become much more relevant than exposure from food. It should also be taken into consideration that the general population is currently exposed to levels of dioxins, which are several orders of magnitude lower than those experienced by the accidentally or occupationally exposed cohorts.

2.5 Toxic Equivalency Factors

TCDD is the most potent and most studied dioxin congener. Because environmental and biological samples in general contain complex mixtures of different dioxin congeners, the concept of Toxic Equivalency Factors (TEFs) has been developed to facilitate risk assessment. These TEFs have been established to express concentrations of mixtures of 2,3,7,8-substituted PCDDs and PCDFs, and more recently, some planar non-ortho and mono-ortho chlorine substituted PCBs in toxic equivalents (TEQs) of 2,3,7,8-TCDD. The concentrations of the individual substances in a given sample are multiplied by their respective TEF and subsequently summed to give total concentration of dioxin-like compounds expressed in TEQs (see Annex 1). The sum of all these individual TEQ contributions represents the total content of dioxin-like compounds in the sample expressed in TEQs.

In 1988, Nordic experts recommended a standardized set of TEF values (N-TEFs) for the PCDDs and PCDFs (Ahlborg et al., 1988). In the same year, an internationally harmonized scheme of TEFs for PCDDs and PCDFs (I-TEFs) was published by NATO/CCMS (1988). In 1994 this was followed by a WHO recommended list of PCB-TEFs for a selection of non-, mono- and di-ortho PCBs (Ahlborg et al., 1994). In 1997, a WHO-consultation re-evaluated the TEFs for PCDDs, PCDFs and dioxin-like PCBs on the basis of an improved database of toxicological information (Van den Berg et al., 1998). Revisions were made in the list of I-TEFs of NATO/CCMS (1988) and in the list of PCB-TEFs published by Ahlborg et al. (1994). These TEF schemes are presented in Annex 1. The use of the new WHO-TEFs instead of the old set of I-TEFs and PCB-TEFs will certainly lead to changes in the TEQ values calculated. The extent of these shifts will, however, depend on the concentrations of the congeners with a revised TEF. The change in the TEF value for 1,2,3,7,8-PeCDD from 0.5 to 1, for instance, will lead to a slight increase in the TEQ value (estimates range between a few % up to 20%)[5], whereas the exclusion of the di-ortho substituted PCBs 170 and 180 will lead to a lower TEQ value. Differences can be expected in the occurrence of dioxins and PCBs in foods between the various countries. Therefore, it is considered too speculative to provide a general estimate of the effects on the TEQ values for foods and dietary intakes resulting from use of the new WHO-TEFs instead of the previous I-TEFs and PCB-TEFs.

2.6 Risk assessment

Several international expert groups in the field of the health risk assessment of dioxins and related compounds have been convened. A Nordic expert group proposed a tolerable daily intake (TDI) of 5 pg/kg body weight (bw) for TCDD and structurally similar chlorinated PCDDs and PCDFs, based on experimental studies on cancer, reproduction and immuno-toxicity. At a WHO meeting in 1990, a TDI of 10 pg/kg bw for TCDD was established, based on liver toxicity, reproductive effects and immunotoxicity, and making use of kinetic data in humans and experimental animals. Since then

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[5] Based on a large dataset of concentrations of PCDDs and PCDFs in human milk from Germany (n=1732, period 1989-1998), the PCDD/F-WHO-TEQ appeared to be on average 16% higher than the corresponding dioxin level expressed in I-TEQ (see contribution of Germany in Annex 2).

new epidemiological and toxicological data have emerged, in particular with respect to neurodevelopmental and endocrinological effects.

In May 1998, a consultation convened by the WHO-ECEH and IPCS re-evaluated the available information and established a TDI range of 1-4 pg TEQ/kg bw for dioxins and dioxin-like PCBs. The consultation focused on the most sensitive effects which are considered adverse (hormonal, reproductive and developmental effects) seen at low doses in animal studies. These effects occur at body burdens in rats and monkeys in the range of 10-50 ng/kg bw. Human daily intakes corresponding with body burdens similar to those associated with adverse effects in animals can be estimated to be in the range of 10-40 pg/kg bw/day. Since body burdens have been used to scale doses across species, the WHO-consultation concluded that the use of an uncertainty factor to account for interspecies differences in toxicokinetics is not required. However, the estimated human intake was based on Lowest Observed Adverse Effect Level (LOAELs) and not on No Observed Adverse Effect Level (NOAELs). Although for many parameters humans might be less sensitive than animals, uncertainty still remains regarding animal to human susceptibilities. Furthermore, differences exist in the half lives of elimination for the different components of a TEQ mixture. To account for all these uncertainties, a composite uncertainty factor of 10 was recommended. The WHO-consultation recognised that subtle effects might already be occurring in the general population in developed countries at current background levels of exposure to dioxins and related compounds. It therefore recommended that every effort should be made to reduce exposure to the lower end of the advised range of 1-4 pg TEQ/kg bw/day (WHO, 1999).

When compared to adults, breast-fed infants are exposed to higher intakes of PCDDs, PCDFs and PCBs on a body weight basis, although for a limited time only. This subject was also discussed at the same WHO consultation on re-evaluation of the TDI. The consultation noted that in studies of infants, breastfeeding was associated with beneficial effects, in spite of the contaminants present. The subtle effects noted in the studies were found to be associated with transplacental, rather than lactational exposure. The consultation therefore reiterated conclusions of previous WHO meetings on the health significance of contamination of breast milk with dioxin-like compounds, namely, that the current evidence does not support an alteration of WHO recommendations which promote and support breast feeding (WHO, 1999).

In several other countries, TDIs have been established for TCDD ranging from 1 to 10 pg TCDD/kg bw. The U.S. Environmental Protection Agency (EPA) calculated a safe dose applying the Linear Multistage Model to liver tumour data observed in female rats after chronic exposure to TCDD. In this model TCDD is treated as a genotoxic carcinogen, with the assumption that no threshold dose exists. They arrived at a lowest safe dose of 0.006 pg TCDD/kg bw/day, corresponding to an acceptable lifetime tumour risk of 10^{-6}. This risk assessment of dioxin is currently under re-evaluation (EPA, 1994).

2.7 Present regulations

Table 1 shows the present regulations with respect to concentrations of dioxins and PCBs in food products in the participating countries.

Table 1: Guidelines and maximum levels for concentrations of PCDDs, PCDFs and PCBs in foods in various European countries

COUNTRY	FOODSTUFFS OF ANIMAL ORIGIN	
	PCDDs and PCDFs	PCBs
Austria	Provisional limits: Pork 2, milk 3, poultry and eggs 5 and beef 6 pg WHO-TEQ(PCDD/PCDF)/g fat	
Belgium	Milk, bovine, poultry, animal fats and oils, eggs and derived products, if >2% fat: 5 pg WHO-TEQ (PCDD/PCDF)/g fat. Pork and derived products, if >2% fat: 3 pg WHO-TEQ (PCDD/PCDF)/g fat.	For the sum of PCBs 28, 52, 101, 118, 138, 153, and 180: Milk and derived products, if >2% fat: 100 ng/g fat Bovine, pork, poultry, animal fats and oils, eggs and derived products, if >2% fat: 200 ng/g fat
Denmark	No national limits	No national limits
Finland	No national limits	No national limits
France	milk and dairy products : 5 pg/g fat	No national limits
Germany	Recommendations for milk and dairy products in pg I-TEQ/g milk fat: < 0.9 (desirable target) >3.0 (identification of sources; measures to reduce input; recommendations for land use; recommendation to stop direct supply of milk products to consumers) > 5.0 (ban on trade of contaminated milk products)	Congener specific limits for PCBs 28, 52, 101, 138, 153 and 180 in foods of animal origin: 0.008-0.6 mg/kg fat or whole weight basis
Greece	No national limits	No national limits
Ireland	International norms	International norms

Table 1. Cont'd

COUNTRY	FOODSTUFFS OF ANIMAL ORIGIN	
	PCDDs and PCDFs	PCBs
Italy	No national limits	Action level for the sum of tri- to octachlorobiphenyls in various foods of animal origin (excluding freshwater and marine fish and derived products): 100 ng/g fat
Luxembourg	Recommended: Pork 2, beef 6 poultry 5, milk 3 and eggs 5 pg/g fat	No national limits
Norway	No national limits	No national limits
Portugal	No national limits	No national limits
Spain	Levels > 5 pg/g fat are considered as non-acceptable in dairy products	No national limits
Sweden	No national limits	PCB 153: Meat products > 10% fat: 0.1, milk and milk products > 2% fat: 0.02 and eggs: 0.1 mg/kg/fat. Meat products < 10% fat: 0.01, milk and milk products < 2% fat: 0.001 and fish: 0.1 mg/kg wet weight
The Netherlands	Dairy products and foods with milk or dairy product as ingredients: 6 pg TEQ/g fat	Congener specific limits for PCBs 28, 52, 101, 118, 138, 153 and 180 in foods of animal origin: 0.02 - 2 mg/kg fat (for fish mg/kg wet weight)
United Kingdom	Guideline for cows' milk: 0.66 ng WHO-TEQ/kg whole milk (16.6 ng WHO-TEQ/kg fat) (IMPORTANT NOTE: WHO-TEQ for dioxins and PCBs together)	

2.8 Report structure

In the following chapters, the results of SCOOP Task 3.2.5 are presented. Chapter 3 explains how the occurrence and dietary intake data were compiled. Chapter 4 summarizes the occurrence data, the food consumption data and the dietary intake assessments, respectively. In chapter 5, the major conclusions and recommendations are outlined.

It was decided to focus the main text on levels and intakes expressed in TEQs. Unless otherwise stated, the TEQ values in this report are based on the use of the International TEFs issued by NATO/CCMS in 1988, and the PCB-TEFs for dioxin-like PCBs as published in 1994 (Ahlborg et al., 1994). The reason for choosing the old scheme of TEFs is simply that the majority of the occurrence and exposure data have been produced using these TEFs for the TEQ calculations. For the congener specific data underlying the TEQ values presented in this report, the reader should contact the contact persons of the participating countries (see list on pages 6 and 7). These contact persons have access to the complete database with detailed accounts of all information that was submitted in the framework of this task.

3 METHODOLOGICAL ASPECTS

3.1 Objective

The methodological aspects and the instructions to be followed to compile the occurrence and exposure data were discussed at a meeting held on 21 October, 1998 in Amsterdam. In order to achieve a sound scientific basis, the SCOOP Working Group agreed that the report should cover an evaluation of dietary intakes of PCDDs, PCDFs and dioxin-like PCBs for the general population of participating countries. In addition, it was considered relevant to include information on sub-populations with higher intakes (e.g. breast-fed infants, high level consumers of fish) as well as information, wherever available, on temporal trends in the dietary exposure to these compounds.

3.2 Compilation of data

General

Participating institutes were asked to provide the following information for their country:

- The occurrence of PCDDs, PCDFs and dioxin-like PCBs (list of requested compounds is attached as Annex 1) in foods and, if available, in human milk.
- Relevant information including sampling and analytical procedures used for the determination of the compounds analysed in the foods.
- Consumption data of the relevant foods.
- Dietary intake and other relevant exposure data available for their country.
- Summaries of the available information for their country. To this end, an electronic version of a common table format was distributed to all participants by the co-ordinating institutes to ease the comparison of data from different Member States.

Occurrence data

Each institute was asked to provide data on concentrations of PCDDs, PCDFs and (dioxin-like) PCBs in foods and human milk on a lipid adjusted basis (pg/g fat) together with the (mean) fat content of the sample(s) analysed. If the data were only available on a product basis, the respective value in combination with the fat content of the sample analysed was requested. For each food product or food group investigated, the mean (median, if available), the range of concentrations found and the number of samples analysed was also requested. In the case of analysis of pooled samples, participants were asked to indicate the average number of samples comprising the pool.

The following information was requested:

- Accurate description of the foods analysed including the origin of the samples, a description of the sampling area (e.g. industrial, waste incineration, rural, random) and the period of collection (month/year). If there were more periods in which these foods have been investigated, these data had to be recorded separately to allow an evaluation of temporal trends.
- Sampling procedures (number of batches, sub-samples, etc.).
- Point of sampling (e.g. port, production sites, retail outlet, etc.)
- Treatment of samples (preparation prior to storage, storage conditions, etc.)
- Information on sample preparation, details of the analytical method, limits of determination (LOD) and validation of the method (reproducibility, repeatability, analytical recovery etc.).
- Evidence for Analytical Quality Assurance.
- Reference to the published data to allow compilation of an overall bibliography.

Food Consumption Data

Where available, participants were requested to provide representative estimates of the consumption of the food items for which occurrence data were available. The difficulties in obtaining food consumption data that are exactly relevant to the particular food are well known. Therefore, it was suggested that the participants provide any available information, together with sufficient information to allow the limitations of the data to be assessed. This data was used in an attempt to identify the main dietary sources of PCDDs, PCDFs and dioxin-like PCBs in each country.

For each of the food items (or groups of foods) and population sub-groups, participants were asked to give:

- The best estimate of the average consumption (expressed as g/day) for whole populations and any relevant subgroup (e.g. infants, toddlers, children, adolescents, adults, etc.), with a specification of age (or age range, if applicable).
- The best estimate of high consumption (90th, 95th or 97.5th%ile, to be stated).
- A reference to the source of the consumption data.

For each source of consumption data, the following information was requested, as available:

- Survey population: for example, information on the individual (specify mean, median and range of age, sex, body weight, other characteristics), household (specify scope e.g. all, single persons excluded).
- Survey method: dietary record/diary, duplicate diet (specify period and frequency, weighted intake, interview, purchase records etc.).
- Period of data collection. Seasonal influences.
- Geographical level, national, regional, urban, rural (specify geographical region covered).
- Sample size (number of participants).
- Scope of data (all foods and beverages consumed, food intake, purchase records, home grown foods, foods eaten outside the home etc.).
- Other variables (e.g. socio-economic data).

Dietary intake estimates

Participants were asked where possible to provide estimates of intakes of dioxins and dioxin-like PCBs for each population group, including any previously published data. The procedure used to estimate mean/median and high level intake had to be clearly described. Intakes had to be expressed both in pg/person/day and pg/kg bw/day (with body weight clearly stated). If possible the food sources most contributing to the dietary intake of dioxin related compounds had to be identified.

Description of the database

The database has been set up in Microsoft® Excel and Access. The participants were asked to provide the information in a common format. A workbook containing different worksheets was used to enter the occurrence, food consumption and intake data.

4 RESULTS AND DISCUSSION

4.1 Occurrence in foods

The collation of occurrence data resulted in a database containing almost 500 entries. Each entry represented a study revealing concentrations of PCDDs, PCDFs or (dioxin-like) PCBs in individual or pooled samples from one of the following seven food groups: cereal and cereal products, eggs, fats and oils, fish and fish products, fruits and vegetables, meat and meat products, and milk and milk products. A description of the studies resulting in the occurrence data for each of the ten countries participating in this SCOOP project are presented in Annex 2. The occurrence data are presented in Annex 3. Some explanation is given below.

Presentation of results

Annex 3 provides information on concentrations of PCDDs, PCDF and dioxin-like PCBs expressed in pg TEQ/g, on a fat or wet weight basis. Unless otherwise stated, the TEQs presented are upper bound estimates assuming the concentrations of non-detected congeners equal the limits of determination (LOD) (for further explanation see the notes at the end of Annex 3).

The number of samples collected, within a pool, and analysed are presented, together with the fat content, the basis for the concentrations presented (i.e. 'fat' or 'product' basis) and a description of the site where the samples were collected. Importantly, each entry has a unique code (ID) and samples analysed have been designated as 'representative for the country' ('rep') or as 'selective sampling' ('sel').

Annex 3 should be considered as a complete overview containing all information considered relevant for inclusion in the SCOOP database. The study specific ID has been used as a key to a more detailed account of the study underlying the data incorporated in Annex 3.

General remarks

Analysis of food products for the presence of dioxins and dioxin-like PCBs is generally undertaken for two purposes, either to enforce current maximum limits, or to assess human exposure to the compounds concerned. For control purposes, the problem of sampling is large. However, the sampling problems related to estimation of dietary intakes are even larger. In addition to the problem related to sampling every single batch or lot of a food product, the samples collected must be representative. This is so that the mean level of the total number of samples collected represents a good estimate of the average content in the food product on the market in the particular geographical area where it is intended to estimate the dietary intake.

Many factors influence how representative surveys of dioxins and related PCBs are: the actual sampling from every batch, the total number of samples, the number of sampling years, knowledge about the market in relation to the distribution of samples (for example, knowledge about the number of producers or farmers, distribution between imported and domestic food products, etc). These factors are important to consider when mean dietary intake over longer periods of time is to be estimated. For example a survey of occurrence of dioxins in milk with relatively few samples and samples from only one season will normally not be representative for the overall situation in a country. As there are many important factors to be considered when determining how representative a survey is, it is not possible to set clear objective rules for the judgement of whether survey data are representative and comprehensive enough for a given country and so relevant for use in estimating dietary intakes. However, consulting all data in this report and the general scientific literature, it is often obvious if it is not relevant or scientifically reasonable to use a set of food occurrence data to estimate dietary intake.

The occurrence data shown in Annex 3 represent measurements performed on samples collected from various sites, including rural and industrial sites in the vicinity of sources that may or may not have led to a local contamination with dioxin and related compounds. The samples were collected in the period 1982-1999. In most cases the reported concentrations appear to be fairly comparable and fall in the same order of magnitude. Cases of elevated concentrations appear to be clearly associated with samples originating from specific contaminated sites. Most of the TEQ concentrations presented in Annex 3 represent an average value resulting from chemical analysis of a number of individual or pooled samples. This means that the range of concentrations as presented should be considered as a distribution of means. The real distribution of dioxin levels in food products is illustrated by the French data set for milk and milk products in Figure 1. The lognormal shape of the frequency distribution is also observed for other food groups.

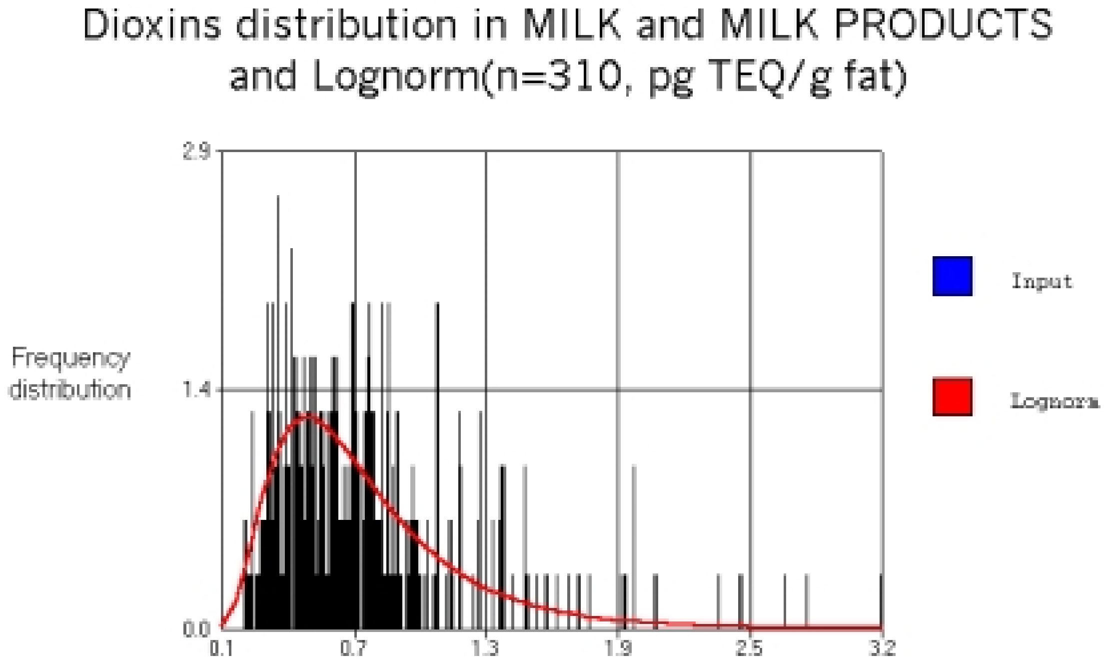

Figure 1: Frequency distribution of concentrations of dioxins in 310 individual samples of milk and milk products collected in France. The lognormal shape of the frequency distribution is also observed for the French datasets for meat and meat products, and for fish and fish products. From : P. Verger (personal communication).

Assessment of data comparability: database incomplete for dioxin-like PCBs

It is widely known that the determination of PCDDs, PCDFs and dioxin-like PCBs requires special expertise and sophisticated instrumentation. Consequently, broad field surveys based on a large number of samples are rare. Most survey data included in this database were obtained by application of state-of-the-art methods to determine congener-specifically the compounds of interest. The methods include conventional and novel extraction techniques, various purification steps and analysis of sample extracts using gas chromatography (GC) with either electron capture detection (ECD) (e.g. mono-ortho and di-ortho PCBs) or high resolution mass spectrometry (HRMS) (PCDDs, PCDFs and non-ortho PCBs). In general both ECD and HRMS methods can provide sufficient specificity and sensitivity to detect the compounds of interest. ECD is widely in use for the determination of the more abundant mono-ortho and di-ortho PCB congeners, although a tendency to use the more selective MS equipment can be noted in the last few years. HRMS is still the only technique capable to achieve the necessary specificity and sensitivity to detect most of the toxic PCDD, PCDF and non-ortho PCB congeners. Without exception the laboratories involved are known to apply state-of-the-art methods for the determination of compounds of interest. From the national contributions included in Annex 2 it also appears that the respective laboratories frequently participate in intercalibration studies. It can therefore be expected that at least for the seventeen toxic PCDDs and PCDFs, the non-ortho PCBs 77, 126 and 169, and the selection of PCBs 138, 153 and 180[6], there was no doubt about the comparability of the occurrence data.

A problem was however identified in the assessment of the comparability of the occurrence data for the selection of mono-ortho PCBs. As a matter of fact, the database is rather incomplete (i.e. too many gaps) to allow an exposure assessment for the total of dioxin-like PCBs on this supranational scale. The problem is caused by differences between the selections of congeners measured to assess the total TEQ contribution of the non- and mono-ortho PCBs. It was therefore decided to extend Annex 3 with information on the selection of congeners determined. In order to provide consistency, the following rules were defined to sort the information provided in the tables.

1. In order to rank the information on the occurrence of dioxin-like PCBs, three different classes of PCBs were distinguished, i.e. the non-ortho ('nor_PCBs'), mono-ortho ('mor_PCBs'), non-ortho and mono-ortho PCBs ('All_PCBs'), and 'ICES 7' congeners (see Annex 3).
2. To justify inclusion of specific data in Annex 3, it was the opinion of the SCOOP Working Group that the reported data should at least be based on a few important congeners. Selected on the basis of their general occurrence in foods, and their relative contributions to the total TEQ, it was decided to use the following congeners as a marker to establish whether or not a study was to be included:

   PCB 126 for non-ortho PCBs,
   PCBs 118, 156 and 157 for mono-ortho PCBs, and
   PCBs 138, 153 and 180 for the ICES 7 PCBs.
3. In order to justify the inclusion of reported data in the summary tables 2 to 5 (presented elsewhere in this report), the respective study should at least provide data on PCB congeners 126, 118, 156 and 157. These congeners are known to contribute most to the TEQ contribution of dioxin-like PCBs.

[6] PCB congeners 138, 138 and 180 belong to the selection of PCBs commonly referred to as ICES-7 (see Glossary) or indicator PCBs. These PCBs have been selected for inclusion in the legislation of many countries.

Comparison of national average concentrations

The data resulting from some studies were considered representative for the country and for use in dietary intake estimates. The judgement of whether the information were representative or not, and so relevant for intake calculations, was made by the participating countries for their own data. In order to compare the concentrations observed in these national representative studies, tables 2 to 5 have been composed. Because some influence of source reducing measures in the participating countries was expected, reported values were aggregated into three consecutive periods and subsequently averaged to evaluate temporal trends. The resulting national averages are listed in table 2 for those food groups the concentrations of which are most often expressed on a fat basis (e.g. eggs, fats and oils, milk and milk products). Table 3 shows the national average concentrations on a product basis for the cereals, fruit and vegetables food groups. The food groups meat and fish comprised various sample types and different species. Therefore it was decided to present the various meats and fish separately in tables 4 and 5, respectively.

Eggs

The most recent surveys on concentrations of dioxins in eggs revealed a range of means between 0.5 and 2.7 pg I-TEQ/g fat. Older studies tend to give a similar picture suggesting that concentrations have not substantially changed. German studies have shown that dioxin levels in eggs will depend on the type of housing (cage, ground, field). Lower levels can be expected for eggs from hens housed in elevated wire cages, while higher levels can be found in eggs from hens that may ingest dioxins from soil (see German contribution in Annex 2 and data in Annex 3). There are only a few studies giving information on levels of dioxin-like PCBs. The limited information shows PCB-TEQ contributions in the same range as for the I-TEQs. A relatively high PCB-TEQ value was reported in a Norwegian study.

Fats and oils

There are many different types of fats and oils of either vegetable or animal origin (e.g. fish oils) that are used in the food industry in the manufacture of different types of food products. A few studies have been reported by the Netherlands, Sweden and the United Kingdom providing national average estimates of the dioxin and PCB content of these fats and oils. I-TEQ and PCB-TEQ concentrations have both been found to be around or below 1 pg TEQ/g fat. Levels are likely to be higher in fish oils compared to other oils. The studies reported indicate concentrations in vegetable oils to be around the limits of determination, and varying levels in fish oils. It is important to note that reported levels in fats and oils may or may not represent the levels in food products brought onto the market by the food industry. Geographical origin, the effect of different refinery methods (which has been shown to reduce the level of contaminants) and the actual price of those fats and oils on the (international) market are important determinants for concentrations of dioxins and PCBs in the composition of fats and oils incorporated in food products (Liem and Theelen, 1997).

Milk and dairy products

The various reports on the occurrence of elevated dioxin levels in the neighbourhood of waste incinerators and other point sources has possibly led to the rather comprehensive database for concentrations of dioxins and PCBs in milk fat as we have it today. The most recent surveys show national average concentrations within the range of 0.3-2.1 pg I-TEQ/g and 0.2-1.8 pg PCB-TEQ/g fat for PCDD/Fs and dioxin-like PCBs respectively.

Many factors should be considered to explain the concentrations of dioxins and PCBs in milk and derived products. At present it is obvious that the deposition on farmland of dioxins emitted through either point or diffuse sources (Fürst et al., 1992; Liem and Theelen, 1997), as well as concentrations present in animal feedstuffs (e.g. Malisch, 1998; Bernard, 1999) are important routes of exposure for cattle. Some effect might therefore be expected from all regulatory measures implemented in the last decade to reduce the dioxin emissions into the environment (Liem and Van Zorge, 1995). As a matter of fact, the national average dioxin levels as presented in table 2 indeed clearly indicate a declining trend in concentrations of dioxins in milk products.

Cereals, fruit and vegetables

The results from the most recent surveys show relatively low concentrations in cereals, fruit and vegetables, mostly around or below the limits of determination (around 0.05-0.1 pg TEQ/g product). The underlying congener specific data often showed non-detects, implying that the upper bound estimates presented in table 2 may overestimate the true concentrations to some extent. It should however be noted that the foods belonging to these food groups are generally consumed in relatively high amounts. Some caution should therefore be taken into account when the results are interpreted in terms of contributions to intake (see chapter 4.3).

Meat and meat products

A large database also exists for levels of dioxins in different types of meat. The food groups most commonly consumed across Europe include beef, pork, poultry and to some extent also mutton. The studies providing information on national average concentrations are presented in table 4. If the levels are expressed on a fat basis, mean dioxin levels in pork are in most cases lower than those reported for beef, poultry and mutton. In addition, concentrations on fat basis in animal livers are without exception relatively higher than the concentrations in the fat tissue of the same animal species. For beef, poultry and mutton, the mean dioxin concentration is in the range of 0.6 to 1.0 pg I-TEQ/g fat. For pork, most studies show levels of below 0.4 pg I-TEQ/g fat. Unfortunately, there are only a few studies were all relevant dioxin-like PCBs have been determined in different types of meats. The limited database shows that TEQ contributions of dioxin-like PCBs are almost similar to those of the PCDDs and PCDFs.

Some studies indicate an inconsistency with the general ranking that 'levels in pork are lower than in other types of meat', and this is in particular the case for the Italian and Swedish data. The reported average dioxin concentrations for pork appeared to be equal to (Sweden) or higher than (Italy) the national averages for beef. The Italian data represents imported meat (Annex 2). The Swedish data is probably a result of relatively high limits of determination leading to large difference between the lower and upper bound estimate (0.4 vs. 1.0 pg I-TEQ/g fat, respectively). Although it is still unclear why the Italian and Swedish data differ from those reported by other countries, it illustrates that certain variations may occur in the dioxin concentrations in foods consumed across Europe. Besides, in view of the growing European food market, a certain influence on the national average concentrations can not be excluded in the near future.

Fish and fish products

The most inhomogeneous food group is formed by the fish and fish products (table 5). This is not only due to the large number of different fish species, but also to the geographical differences in the level of contamination of the various fishing grounds from which these fish originate. The concentrations of dioxins and PCBs vary considerably. Many species contain dioxins and dioxin-like PCBs at levels below 1 pg I-TEQ/g and 1 pg PCB-TEQ/g wet weight, respectively. In some fish species such as crab, eel, and whitefish, higher concentrations should be taken into consideration. The same holds for fish caught in relatively higher polluted areas such as Baltic herring, and fish products (e.g. cod liver) from the same region.

Table 2: National average concentrations of dioxins and related PCBs (in pg TEQ/g fat) in representative food samples

Food group	TEQ PCDD/F			TEQ PCB		
Country	<1990	1990-1994	1995-1999	<1990	1990-1994	1995-1999
eggs						
DE		1.08	1.16			
FI		1.55				
FR			0.46			
IT			2.67			
NL		2.00	1.08			
NO		1.97			8.91	
SV			1.03			1.45
UK	8.25	1.77		2.36	0.97	
fats and oils						
NL		1.51				
SV			0.77			0.42
UK	1.26	0.26		1.29	0.35	
milk / milk products						
BE		2.60	2.06			
DE	1.92	0.86	0.57			
DK	2.26		0.49			
FI		0.99	0.34			0.23
FR			0.67			
IT			0.57			
NL		1.56	0.94			
NO		0.32			1.28	
SV	2.02	0.92	0.75			0.43
UK	3.98	1.41	1.01	2.22	0.91	1.80

Table 3: National average concentrations of dioxins and related PCBs (in pg TEQ/g product) in representative food samples

Food group	TEQ PCDD/F			TEQ PCB		
Country	<1990	1990-1994	1995-1999	<1990	1990-1994	1995-1999
cereals / cereal products						
FI			0.02			0.00
FR			0.02			
NL		0.01				
SV			0.17			0.11
UK	0.08	0.11		0.08	0.02	
fruit and vegetables						
DE		0.01	0.01			
FI			0.02			0.01
FR			0.06			

Table 4: National average concentrations of dioxins and related PCBs (in pg TEQ/g fat) in representative meat samples

Food group	TEQ PCDD/F			TEQ PCB		
Country	<1990	1990-1994	1995-1999	<1990	1990-1994	1995-1999
beef						
DE		0.71	0.66			
DK	2.60					
FI		0.02				
IT			0.70			
NL		1.77	0.72			
NO		0.33			1.35	
SV			0.98			1.08
liver chicken						
NL		3.30				
liver cow						
DE			2.60			
FR			3.29			
IT			2.30			
NL		5.70				
SV			0.95			1.65
liver pig						
DE			3.00			
NL		15.4				
NO		5.10				

Table 4 (Cont'd)

Food group	TEQ PCDD/F			TEQ PCB		
Country	<1990	1990-1994	1995-1999	<1990	1990-1994	1995-1999
pork						
DE	0.39	0.35	0.29			
FI		0.29				
IT			1.39			
NL		0.43	0.23			
NO		0.20				
SV			0.98			0.81
poultry						
DE		0.62	0.58			
IT			0.92			
NL		1.63	0.89			
SV			0.77			0.70
UK	5.40	1.68		2.42	0.93	
lamb/mutton						
DE	1.83	0.52				
NL		1.80				
NO		0.31				
SV			1.01			0.86

Table 5: National average concentrations of dioxins and related PCBs (in pg TEQ/g product) in representative samples of fish and fish products

	TEQ PCDD/F			TEQ PCB		
Country	<1990	1990-1994	1995-1999	<1990	1990-1994	1995-1999
Alaska pollock						
DE			0.01			
anchovy						
IT			0.35			
burbot						
SV	0.87					
carp						
DE			0.74			
catfish						
DE			0.52			
clam						
IT			0.10			
coalfish						
DE			0.07			
cod						
DE			0.05			
NO	0.12	0.20				
SV			0.13			0.23
UK			0.03			0.07
crab						
NO			10.2			
dietary supplements						
UK		5.55	3.55		10.1	14.2
eel						
DE			1.64			
UK			1.55			8.39
haddock						
DE			0.04			
UK			0.03			0.03
hake						
DE			0.03			

Table 5 (Cont'd)

Country	TEQ PCDD/F <1990	TEQ PCDD/F 1990-1994	TEQ PCDD/F 1995-1999	TEQ PCB <1990	TEQ PCB 1990-1994	TEQ PCB 1995-1999
halibut						
DE			0.46			
herring						
DE	1.40		0.79			
NO		0.91			2.64	
SV	1.85		0.73			1.11
UK			2.10			6.24
herring Baltic						
DK	9.09					
FI		8.00				
SV	8.27	10.5	3.18			1.33
liver burbot						
SV	87.8					
liver cod						
NO		2.67			29.7	
liver cod Baltic						
DK	28.6					
mackerel						
DE			0.29			
IT			0.86			
NO		0.52			1.40	
UK			0.61			2.50
mussel						
IT			0.17			
Norway lobster						
IT			0.12			
pike						
SV			0.90			0.67
plaice						
DE			0.28			
NO		0.19			2.62	
UK			0.25			0.48

Table 5 (Cont'd)

Country	TEQ PCDD/F <1990	TEQ PCDD/F 1990-1994	TEQ PCDD/F 1995-1999	TEQ PCB <1990	TEQ PCB 1990-1994	TEQ PCB 1995-1999
red mullet						
IT			0.44			
redfish						
DE			0.23			
salmon						
UK			0.71			2.39
salmon Baltic						
SV			7.04			9.12
salmon farmed						
DE			0.43			
NO		0.95			3.99	
SV			1.04			1.16
sardine						
DE			0.43			
squid						
IT			0.18			
trout						
DE		0.33	0.43			
trout farmed						
DE			0.26			
FI		1.79	0.74			1.49
SV			0.81			1.14
UK			0.24			0.87
tuna						
DE			0.01			
whitefish						
SV	7.40					
whiting						
UK			0.03			0.11

Table 5 (Cont'd)

	TEQ PCDD/F			TEQ PCB		
Country	<1990	1990-1994	1995-1999	<1990	1990-1994	1995-1999
Mixtures						
fatty sea fish mixture						
NL		1.09				
fish food group						
UK	0.41	0.21		0.90	0.42	
fish mixture						
DE	0.70		0.29			
SV			0.39			0.55
freshwater fish						
NL		0.18				
lean sea fish mixture						
NL		0.44				
sea fish mixture						
DE		0.17	0.48			
FR			0.63			
sea food mixture						
FR			1.41			

4.2 Occurrence in human milk

A considerable amount of data exists for concentrations of PCDDs and PCDFs in human milk. The national average concentrations of PCDDs, PCDFs and dioxin-like PCBs, expressed in I-TEQs and PCB-TEQs respectively, are presented in table 6. For the period 1995-1999 the current database shows national average concentrations between 8 and 16 pg I-TEQ/g fat. For the period before 1995, the national averages ranged between 10 and 34 pg I-TEQ/g fat. The database is too incomplete to draw a firm conclusion about the TEQ contribution of dioxin-like PCBs. The few studies conducted have been performed in the period 1990-1994 and indicate a mean PCB-TEQ concentration varying from comparable to three times the I-TEQ contribution of PCDDs and PCDFs (7-29 pg PCB-TEQ/g fat).

Table 6: National average concentrations of dioxins and related PCBs (in pg TEQ/g fat) in representative human milk samples

human milk	TEQ PCDD/F			TEQ PCB		
Country	<1990	1990-1994	1995-1999	<1990	1990-1994	1995-1999
BE		24.8			6.63	
DE	30.7	20.6	13.8			
DK	18.1	16.7			18.0	
FI	20.0	13.2		25.3	12.0	
FR			16.4			
IT	25.0					
NL	34.2	23.5			20.9	
NO		10.4			29.1	
SV		13.3	7.90		19.4	
Range of means	*18-34*	*10-25*	*8-16*	*25*	*7-29*	*no data*

General remarks

Since the first report on the presence of 2,3,7,8-substituted PCDDs and PCDFs in human milk levels of European origin (WHO, 1985; Nygren et al., 1986), numerous studies have been performed showing that these compounds accumulate in human adipose tissues and can be excreted in human breast milk resulting in exposure of the nursing infant (Jensen and Slorach, 1991; WHO/ECEH, 1996). It is nowadays clear that the concentrations observed in human milk reflect the accumulation by the mothers during their life. The exposure starts *in utero* and proceeds after birth through the ingestion of breastmilk and foods. The level of exposure during the mother's life, as well as the number of previously breastfed children, residential factors, personal characteristics (e.g. age, particular food consumption habits, occupational factors) and various toxicokinetic factors will finally lead to the level observed in human milk. Besides, several methodological factors such as methods for sample collection (e.g. time after delivery), storage and transportation of samples have been found to be relevant. All these factors may lead to differences between the mean concentrations of dioxins and PCBs as observed in the various studies on human milk. It should be noted, however, that these differences can be even larger when the levels in individual samples from the same population are compared (Fürst et al., 1994; Koopman-Esseboom et al., 1994; Liem and Theelen, 1997). The latest WHO field study on human milk revealed a coefficient of variation of 30-40% for variations in the I-TEQ level of individual samples (WHO/ECEH, 1996). So, both methodological as well as population and individual characteristics should be taken into account to explain the differences occurring in table 6.

Time trends

The current database generally demonstrates a downward trend with respect to human milk concentrations of PCDDs and PCDFs. The database is too limited to assess a time trend for dioxin-like PCBs. The most complete time course has been reported for Germany. The German database represents studies comprising in total more than 1732 individual samples collected in various German ‘Bundesländer’ in the period 1985-1998 (results presented in Annex 2). The German database shows a 60% decline in the average as well as in the highest dioxin levels found in human milk between the late 1980s and 1998.

4.3 Food consumption data and dietary intake estimates

Food consumption data derived from various studies were used to calculate the intake of dioxins and PCBs. Details of the surveys are given in table 7. Most countries had access to national representative dietary surveys, with the exception of Belgium. For infants, data on breast milk intake were available for some countries. The period of collection of the data ranged from 1985 to 1999. The food consumption data were combined with occurrence data for dioxins and PCBs. The coverage of foods generally included foods of animal origin, while foods of vegetable origin were less represented in many countries. For some countries analytical data from various periods were used. In addition, some data based on analysis of duplicate or total diets (Germany, the Netherlands, Sweden, UK) were available. More information on the methods of collection is given in Annex 2.

Infants and children

Intakes of dioxins and PCBs from breast milk among infants were available for United Kingdom and Germany (see Annex 5). Intakes were calculated combining occurrence data for dioxins and PCBs in breast milk with observed breast milk consumption during the first year. Fig. 2 shows the intakes among British infants 2-10 months old. The decrease in intake after 3 months is a reflection of the decrease in milk consumption. Intakes from other foods are not included. The time trend of German data on human milk shows a clear decline of dioxin intake of infants by breast-feeding during the last 10 years (Fig. 3).

Few data were also available for children. Table 8 gives recent average intakes of dioxins and PCBs among children and adolescents 1.2-18 years old. Intakes of dioxins ranged from ca. 22 pg/d among German toddlers to ca. 78 pg/d among British school children and French adolescents. Expressed per kg body weight the intakes were higher among the younger than among adolescents. Besides, the mean daily intake per kg body weight is for children about 2-4 fold higher than for adults. This is a consequence of the lower body weight of the children. In addition, other consumption habits have to be taken into account.

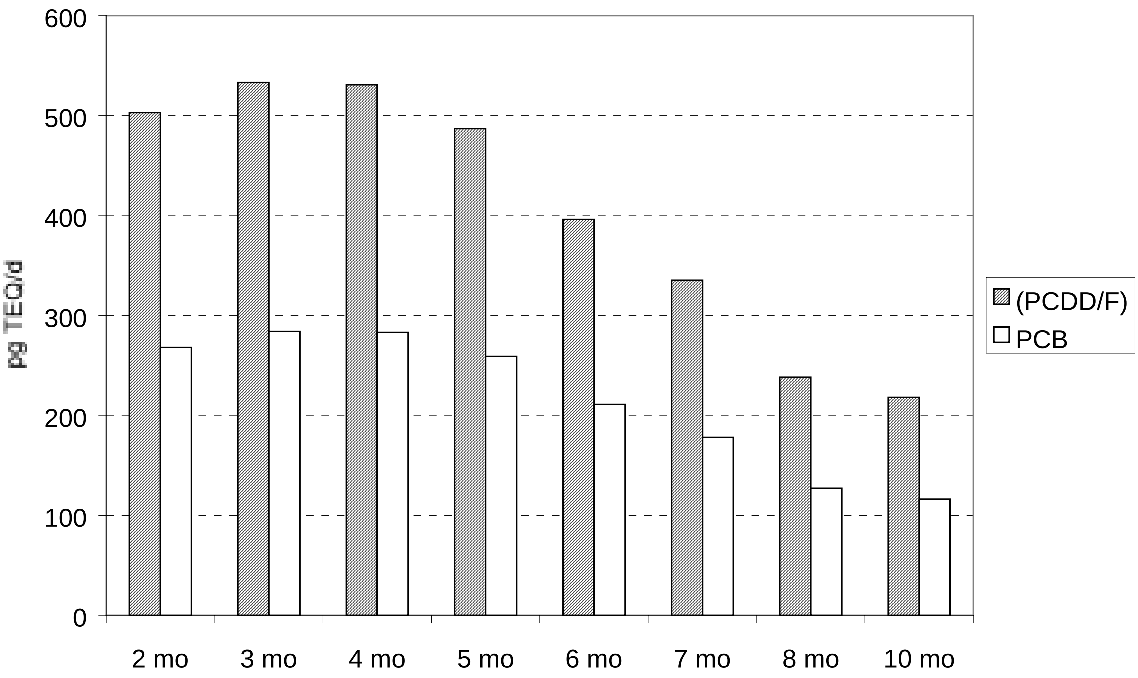

Fig 2. Daily intakes of dioxins and PCBs from breast milk among British infants. Data from MAFF (1997).

Adults or total population

The mean intakes of adults obtained from the most recent surveys are shown in table 8. Data for older surveys are, together with the recent ones, listed in Annex 4. For the period after 1995 the average intakes of dioxins, expressed as I-TEQs, varied between 29 pg/d in Norway and 97 pg/d in France. Expressed per kg body weight the intakes ranged from ca. 0.4-1.5 pg/d. For surveys for which analytical data were from the 1970s and 1980s, intakes were higher, ranging from 127 pg/d to 300 pg/d (see Annex 4).

The data for dioxin-like PCBs are more incomplete. Finland, the Netherlands, Norway, Sweden and the United Kingdom provided data. Average intakes ranged from 57-110 pg PCB-TEQ/d. The coverage of the dioxin-like PCB congeners in the analyses is not complete, and for Finland PCB data for some animal foods (eggs, meat) were missing which means that the intake is somewhat under-estimated.

Data for the total intake of TEQs were available for 4 countries (Finland, Norway, Sweden and UK) and were very similar, 111-145 pg TEQ/d. In Norway PCBs provided the major part of the total TEQs, while the dioxins were more important in the other three countries (table 8).

Dietary sources of dioxins

Table 9 lists the average sources of dioxins in the diets of adults or total population. Dairy products contributed 16-39%, meat 6-32% and fish 2-63% of the average daily intake. Other products, mainly of plant origin such as vegetables, fruit, cereals and vegetable fats, contributed 6-45% in those countries for which data were available. The data have to be interpreted with some caution, since for some countries intake data do not cover all food groups consumed, e.g. plant foods. In addition, estimates for plant products are often based on non-detectable levels using LOD as the value. For UK the data for other foods, e.g. cereal products, include ingredients such as fats. In addition, the dietary and occurrence data are from different time periods.

High intakes

The data in table 8 refer to average intakes for the specified population groups. These estimations also include subjects with no consumption of the specified foods. The intake by "high" consumers, defined as the upper 5% of the population (95-percentile intake) can be 2-3 fold higher than the average, depending on the degree of contamination of various foods. In the British and Dutch surveys of adults or total population the 95-percentile intake of dioxins was about 1.6-2.9 times the average intake. Using the same approach, high consumers of specific foods or food groups can also exceed average dioxin intakes considerably, depending on the contamination level. Data from, e.g. Norway, Sweden and UK, show that dioxin intakes among high consumers of margarine fat, dairy fat or fish can be estimated to be 1.5-2 times higher than the average intake. In special groups, such as anglers and fishermen in the Nordic countries with a high consumption of fatty fish, the intake of dioxins and PCBs can be considerably higher.

Table 7. Dietary survey data

Country	Survey	Sex/Age	Sample size	Period	Survey method	Region	Reference*	Repre-sentative
Children								
Germany	Breast fed infants	M&F 4 mo		1992-98	Breast milk consumption	all Germany	Wallgren (1945)	yes
Germany	Toddlers, duplicate diets	M&F 22 mo-5 yr	14	1995	3 d record	NR Westphalia	Schrey et al. (1996)	yes
Germany	Toddlers, duplicate diets	M&F 14-47 mo	42	1998	7 d record	NR Westphalia	Wittsiepe et al. (1999)	yes
United Kingdom	British Schoolchildren's study	M&F 10/11,14/15	2697	1983	7d record	all UK	DH/COMA (1988)	no
United Kingdom	British Toddlers study	M&F 1.5-4.5	1675	1992/93	4d record	all UK	Gregory (1995)	yes
United Kingdom	Breast fed infants	M&F 2-10 mo	48	1978/80	Breast milk consumption	Cambridge	Paul et al. (1988)	no
Adults								
Finland	Finnrisk 1992	M&F 25-64	1861	1992	3d record	four regions	Kleemola et al. (1994)	yes
Finland	Finsurvey 1997	M&F 25-64	2862	1997	24 h recall	five regions	KTL Publication B8/1998	yes
France	Dietary survey	M&F 2-75	3003	1998-99	7d record	all France	INCA - OCA/CREDOC (1998/1999)	yes
Germany	Report of Nutrition	M&F 4->65	23209	1985-89	7d record	all Germany	Kübler (1994 and 1995)	yes
Germany	Duplicate diets	M&F 24-64	14	1994-95	3 d record	NR Westphalia	Schrey et al. (1995)	yes
Germany	Duplicate diets	M&F	12	1994	28 d record	Saxony-Anhalt	Grün et al. (1995)	yes
Italy	INN-CA 1995	M&F 1-92	3000	1994-1996	HBS	all Italy	Conforti P. et al. (1996)	yes
Netherlands	DNFCS 1987/1988	M&F 1-85	5898	1987-1988	2d record	all Netherlands	DNFCS (1988)	yes
Netherlands	DNFCS 1992	M&F 1-85	6218	1992	2d record	all Netherlands	DNFCS (1992)	yes
Netherlands	DNFCS 1998	M&F 1-85	5958	1997-1998	2d record	all Netherlands	DNFCS (1998)	yes
Netherlands	Duplicate diets	M&F 21-60	93	1978	24 h DD	one region	Liem and Theelen (1997)	yes
Netherlands	Duplicate diets	M&F 18-74	109	1984-85	24 h DD	one region	Liem and Theelen (1997)	yes
Netherlands	Duplicate diets	M&F 18-74	121	1994	24 h DD	one region	Liem and Theelen (1997)	yes
Norway	NORKOST 1997	M&F 16-79	2672	1997	FFQ	all Norway	Johansson et al. 1997	yes
Sweden	Riksmaten 1997-98	M&F 18-74	1215	1997-98	7d record	all Sweden	Becker (1999)	yes
Sweden	Market Basket		100 foods	1999	MB	4 major towns	unpublished	yes
UK	British Adult Study	M&F 16-64	2197	1986/87	7d record	all UK	Gregory et al. (1990)	yes

* Full references are given in Annex 2.

Table 8. Dietary intake of dioxins and PCBs (pg TEQ/d*) according to recent surveys

Country	Survey	Period	Sex/Age	Body weight kg	Region	Occurrence data	Mean intake (pg TEQ/d) (PCDD/F)	PCB	total	per kg bw (PCDD/F)	PCB	total	Comments
Children and adolescents													
Germany	Toddlers, duplicate diets	1995	M&F 22 mo-5 yr		NR Westphalia	1995	44	na		2.6	na		
Germany	Toddlers, duplicate diets	1998	M&F 14-47 mo	13.4	NR Westphalia	1998	22	na		1.61	na		
France	National survey	1998-99	M&F 15-18	59.7	all France	1998-99	77.9	na		1.31	na		nd=LOD
France	National survey	1998-99	M&F 3-14	31.6	all France	1998-99	72.0	na		2.28	na		nd=LOD
United Kingdom	British School-children's study	1983	M&F 10/11,14/15	43.4	all UK	1992	78.5	45.4	123.9	1.81	1.05	2.85	nd=LOD
United Kingdom	British Toddlers study	1992/93	M&F 1.5-4.5	14.4	all UK	1992	48.6	31.2	79.9	3.38	2.17	5.55	nd=LOD
Adults or total population													
Finland	Finsurvey	1997	M&F 25-64	60.0	5 major regions	1991-99	60.8	50.5	111.2	1.01	0.84	1.85	nd=LOD
France	Dietary survey	1998-99	M&F 18-75	67.1	all France	1998-99	97.1	na	-	1.45	na	-	nd=LOD
Germany	Report of Nutrition	1985-89	M&F 25-50	70	all Germany	1991-95	104	na	-	1.47	na	-	nd=0.5*LOD
Germany	Report of Nutrition	1985-89	M&F adults	70	all Germany	1993-96	61.3	na	-	0.88	na	-	nd=0.5*LOD
Germany	Duplicate diets	1994	M&F		Saxony-Anhalt	1994	61.5	na	-	0.85	na	-	nd=0.5*LOD
Germany	Duplicate diets	1994-95	M&F 24-64		NR Westphalia	1994-95	49	na	-	0.72	na	-	nd=0.5*LOD
Germany	Report of Nutrition	1985-89	M&F adults	70	all Germany	1995	69.6	na	-	1.0	na	-	nd=0.5*LOD
Germany	Report of Nutrition	1985-89	M&F adults	70	all Germany	1995-98	37	na	-	0.53	na	-	nd=LOD
Germany	Report of Nutrition	1985-89	M&F 25-50	70	all Germany	1995-98	50.9	na	-	0.73	na	-	nd=0.5*LOD
Italy	INN-CA 1995	1994-1996	M&F 1-92	61.1	all Italy		45.1	na	-	0.74	na	-	nd=0.5*LOD
Netherlands	DNFCS 1992	1992	M&F 1-85	63.1	all Netherlands	1994-96	41	na	-	0.59	na	-	nd=LOD
Norway	NORKOST 1997	1997	M&F 16-79	73.5	all Norway	1989-96	29.0	110.2	139.2	0.39	1.50	1.89	nd=LOD
Sweden	Riksmaten 1997-98	1997-98	M&F 18-74	73.7	all Sweden	1998-99	78	63	141	1.06	0.85	1.91	nd=LOD
Sweden	Market Basket	1999	-	73.7	4 major towns	1999	79	58	138	1.07	0.79	1.87	nd=LOD
United Kingdom	British Adult Study	1986/87	M&F 16-64	70.1	all UK	1992	88.3	56.5	144.8	1.26	0.81	2.07	nd=LOD

*TEF factors used, unless otherwise stated: PCDD/F = NATO/CCMS (1998); PCB = Ahlborg et al. (1994); nd= not detected; na = not assessed. A complete overview, including older surveys is presented in Annex 4.

Table 9: Average percent contribution of dioxins (I-TEQ) from major food groups. Adults or total population.

Country	Food consumption data	Occurrence data	Total intake pg/d	% contribution from Dairy products	Meat, poultry	Eggs	Fish	Other foods*
FI	Finsurvey 1997	1991-99	61	16	6	4	63	11
FR	National survey 1998-99	1998-99	97	33	13	2	26	26
DE	1985-89	1995-98	51	39	30	11	11	9
IT	INN-CA 1995		45	26	32	7	35	-
NL	National survey 1987-88	1990-91	82	39	20	4	*2*	35
NO	NORKOST 1997	1989-96	29	22	14	12	46	6
SE	Riksmaten 1997-98	1996-99	68	19	31	2	34	14
UK	Adult survey 1986-87	1992	88	25	20	4	6	45
Range		*1989-99*	*29-97*	*16-39*	*6-32*	*2-12*	*2-63*	*6-45*

***other foods = cereals and cereal products, vegetables, fruit, vegetable fats and oils**

Time trends

For some countries, i.e. Germany, the Netherlands and United Kingdom, intake data were available for different periods. Generally, there is a decreasing trend in dioxin intakes since the late 1970s and 1980s. The decrease in the dietary intakes is comparable with the downward trend in the levels of dioxins in human milk. Fig. 3 shows the intake of dioxins from breast milk among 4 months old German infants using analytical data for breast milk from different periods. Another example of this is given in Fig. 4, showing results from duplicate portion studies of Dutch adults. Similar trends were seen in the other countries, see Annex 4. The decrease in intakes is mainly due to lower levels of the contaminants rather than changes in food consumption.

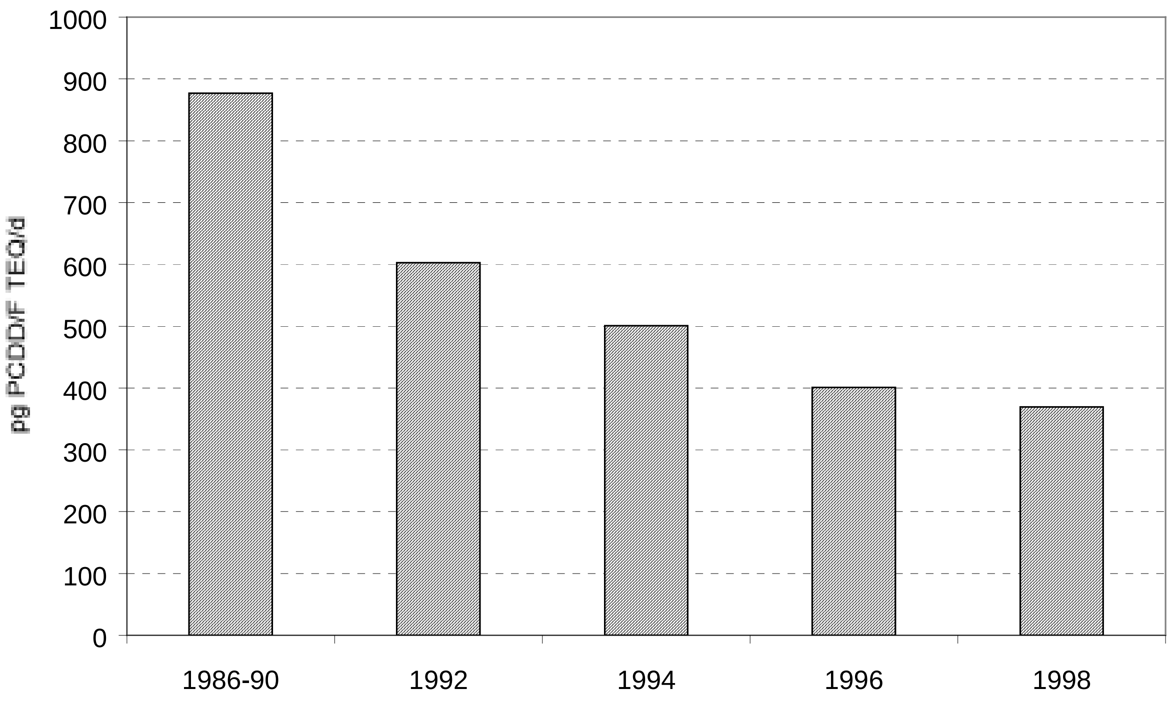

Fig 3. Calculated daily intakes of dioxins from breast milk among German infants 4 months old using analytical data from different time periods. Data from Annex 3 and 5.

Fig 4. Average intake of dioxins and PCBs (expressed per kg bw and day) in Dutch adults according to duplicate diet studies. Data from Liem&Theelen (1997).

Comments

The comparability of the intake estimations for the various countries are hampered by several factors, e.g. period of collection of dietary and analytical data, coverage of dioxin and PCB congeners, handling of levels below the limit of determination in the calculation of TEQs, survey method and missing data.

The method used to estimate TEQ levels when individual congeners are below the limit of determination can influence the intake estimations significantly. It was agreed, as far as possible, to use a value equal to the limit of determination (LOD) when congener levels were not detectable (nd). The impact of using LOD instead of zero on the intake estimates was generally moderate, dioxin intakes increased by 10-20%. Larger differences were observed for estimates from Sweden and Norway. The estimated mean dioxin intake in Sweden was 78 pg/d using nd equal to LOD and 39 pg/d using nd equal to zero. The estimated mean intake of dioxin-like PCBs in Norway was 110 pg/d using nd equal to LOD and 66 pg/d using nd equal to zero. These larger differences might be due to the degree of sensitivity of the analytical procedures.

The method used for measuring food consumption influences the quality and reliability of data and also affects the interpretation of intake estimations. In many instances food consumption is underestimated, when methods such as dietary records, 24 h recall and fixed food frequency questionnaires are used. The number of days the method covers will influence the assessment of high and low intakes and the proportion of consumers and non-consumers. Methods covering 1-2 days (used in the Netherlands) or food frequency questionnaires (used in Norway) will tend to overestimate the extreme intakes. Most methods are able to give a fair estimate of the average food consumption in a population. Ideally 1-2 weeks are needed to obtain reliable data on average intake at the individual level and to provide a fair picture of the distribution within the population. Household budget surveys, used by Italy, measure the acquisition of food by households. They provide data on the average availability of foods as purchased for the entire household and do not give the actual intake.

For many countries, occurrence data for some foods consumed by the population are missing. Most of the analytical data refer to animal foods since these were generally regarded to be the main contributors of dietary dioxins and PCBs. Data for plant foods such as bread and other cereals, fruit and vegetables are more scarce. In those countries for which occurrence data were available, these products generally provided a relatively small part of the daily intake. In addition, estimates for many plant products are often based on non-detectable levels of the individual congeners using LOD as the value, which might result in an overestimation of the actual intake.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The numerous studies conducted so far have resulted in a comprehensive database to compare the levels and the intakes of the seventeen toxic 2,3,7,8-substituted PCDDs and PCDFs in foodstuffs, and in tissues of animals and humans. Unfortunately this is in general not yet the case for the dioxin-like PCBs.

The available information on the occurrence of dioxins in foods consumed in the participating countries shows national average concentrations[7] of PCDDs and PCDFs in eggs, fats and oils, meat (products) and milk (products) of generally less than 1 up to 2-3 picogram (pg) I-TEQ[8] per gram (g) of fat. PCDD and PCDF levels in fish ranged between 0.25 and 10-20 pg I-TEQ/g on product basis. Concentrations in fruits, vegetables and cereals were found to be relatively low, and were generally close to the limits of determination. The limited information with respect to concentrations of dioxin-like PCBs indicates average TEQ[9] contributions of one to two times the TEQ contribution of PCDDs and PCDFs.

A considerable amount of data exists for concentrations of PCDDs and PCDFs in human milk. For the period before 1995, the national averages ranged between 10 and 34 pg I-TEQ/g fat. For the period 1995-1999 the national average concentrations ranged between 8 and 16 pg I-TEQ/g fat, for some countries clearly indicating a downward trend.
The database is not sufficiently complete to draw a firm conclusion about the TEQ contribution of dioxin-like PCBs. The few studies conducted have been performed in the period 1990-1994 and indicate a mean PCB-TEQ concentration varying from comparable to three times the I-TEQ contribution of PCDDs and PCDFs (7-29 pg PCB-TEQ/g fat).

For the period after 1995, the average dietary intake of PCDDs and PCDFs for an adult person has been estimated to be between 29 and 97 pg I-TEQ/day, which on a body weight (bw) basis corresponds to approximately 0.4-1.5 pg I-TEQ/kg bw/day. For surveys based on chemical analyses

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[7] All concentrations represent upper bound estimates assuming nondetects equal the limits of determination.

[8] TEQ contribution of PCDDs and PCDFs calculated using International TEFs according to NATO/CCMS (1988).

[9] TEQ contribution of dioxin-like PCBs calculated using WHO-TEFs according to Ahlborg et al. (1994).

of foods collected in the 1970s and 1980s, intakes were estimated to be higher, ranging from 127 to 314 pg I-TEQ/day (approx. 1.7-5.2 pg I-TEQ/kg bw/day). The 95-percentile intake, based on data from the United Kingdom and the Netherlands was 2-3 times the mean intake.

If the TEQ contribution of dioxin-like PCBs is considered, the average intakes were between 48 and 110 pg PCB-TEQ/day (approx. 0.8-1.8 pg PCB-TEQ/kg bw/day). In studies investigating both dietary intakes of PCDDs/PCDFs and PCBs, the TEQ contribution of dioxin-like PCBs was estimated to be almost equal (e.g. Finland, Netherlands, Sweden, United Kingdom) to approximately four times (Norway) the TEQ contribution of the PCDDs and PCDFs.

The main contributors to the average daily intake of dioxins (I-TEQ) in the participating countries are milk and dairy products (contributions ranged from 16-39%), meat and meat products (6-32%) and fish and fish products (2-63%). Other products, mainly of plant origin such as vegetables, cereals, contributed 6-45% in those countries for which data were available. In this regard, it should be noted that the ranking of the food groups in their contribution to the total intake of I-TEQ differed from country to country. These differences may result from different food consumption habits in the participating countries. On the other hand, other factors may also be involved. These include factors related to the applied sampling strategy (e.g. differences in the coverage of products collected to represent the whole food group) and the large variations in concentrations of dioxin related substances in some of the food groups (e.g. vegetables and fruits, eggs and fish).

In most countries young children will have a higher intake per kg body weight than adults. This is especially true during the breast-feeding period. On a body weight basis, the intake of breast-fed infants has been estimated to be 1 to 2 orders of magnitude higher than the average adult intake. For high level consumers of one or more of the dioxin-containing products the contribution from these products could be of significant importance for the total dietary intake of dioxins and related PCBs.

A few countries (i.e. Finland, Germany, Netherlands, Sweden and the United Kingdom) reported sufficient data for the establishment of time trends in the dietary exposure and levels in human milk. These data reveal clearly that the exposure of the general population to dioxins is declining. For Germany, Finland, Netherlands and Sweden this decline is also noted for concentrations in human milk.

5.2 Recommendations

A regular collation of occurrence and food consumption data is extremely valuable in order to compare and to follow temporal trends in the exposure of the populations of different European countries to dioxin and related compounds. These compilations should be ideally performed on a 5 or 10 year basis.

European countries other than those that took part in SCOOP Task 3.2.5 are strongly encouraged to add their information into the established SCOOP database, and to take part in any future EU scale dioxin project.

Future studies should not only focus on national average concentrations but also on the distribution of these concentrations. Wherever possible, the sources most likely to lead to the occurrence of these compounds should be identified. In order to allow these type of investigations, analytical data should become available on a congener specific basis rather than on a TEQ basis only.

The available database is insufficient to assess the current situation with respect to dioxin-like PCBs. It is strongly recommended to include the selection of dioxin-like PCB congeners as recommended by WHO (Van den Berg et al., 1998) in future monitoring activities. Especially because the available information shows that TEQ contributions of dioxin-like PCBs are at least comparable with the contribution of PCDDs and PCDFs.

Interlaboratory comparison studies should be conducted in EU framework in order to be able to assess the between-lab comparability of the chemical information included in the database.

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ANNEX 1

Congeners of PCDDs, PCDFs and PCBs selected for compilation of occurrence and exposure data in the framework of SCOOP Task 3.2.5 (Dioxins)

PCDDs and PCDFs	**Toxic Equivalency Factor (TEF)**	
	I-TEF (NATO/CCMS, 1988)	WHO-TEF (Van den Berg et al., 1998)
2,3,7,8-TCDD	1	1
1,2,3,7,8-PeCDD	0.5	1
1,2,3,4,7,8-HxCDD	0.1	0.1
1,2,3,6,7,8-HxCDD	0.1	0.1
1,2,3,7,8,9-HxCDD	0.1	0.1
1,2,3,4,6,7,8-HpCDD	0.01	0.01
OCDD	0.001	0.0001
2,3,7,8-TCDF	0.1	0.1
1,2,3,7,8-PeCDF	0.05	0.05
2,3,4,7,8-PeCDF	0.5	0.5
1,2,3,4,7,8-HxCDF	0.1	0.1
1,2,3,6,7,8-HxCDF	0.1	0.1
1,2,3,7,8,9-HxCDF	0.1	0.1
2,3,4,6,7,8-HxCDF	0.1	0.1
1,2,3,4,6,7,8-HpCDF	0.01	0.01
1,2,3,4,7,8,9-HpCDF	0.01	0.01
OCDF	0.001	0.0001

PCBs	**Toxic Equivalency Factor (TEF)**	
	PCB-TEF (Ahlborg et al., 1994)	WHO-TEF (Van den Berg et al., 1998)
Non-ortho PCBs		
3,3',4,4'-CB(77)	0.0005	0.0001
3,4,4',5-CB(81)	-	0.0001
3,3',4,4',5-CB(126)	0.1	0.1
3,3',4,4',5,5'-CB(169)	0.01	0.01
Mono-ortho PCBs		
2,3,3',4,4'-CB(105)	0.0001	0.0001
2,3,4,4',5-CB(114)	0.0005	0.0005
2,3',4,4',5-CB(118)	0.0001	0.0001
2,3,4,4'5-CB(123)	0.0001	0.0001
2,3,3',4,4',5-CB(156)	0.0005	0.0005
2,3,3',4,4',5'-CB(157)	0.0005	0.0005
2,3',4,4',5,5'-CB(167)	0.00001	0.00001
2,3,3'4,4'5,5'-CB(189)	0.0001	0.0001
*Other PCBs**		
2,2',3,3',4,4'-CB(138)	-	-
2,2',4,4',5,5'-CB(153)	-	-
2,2'3,4,4'5,5'CB(180)	0.00001	-

* The list of PCB-TEFs for dioxin-like PCBs as published by Ahlborg et al. (1994) also contained a TEF value for 2,2',3,3',4,4',5-chlorobiphenyl, or PCB congener with IUPAC no. 170 (PCB-TEF = 0.0001).

ANNEX 2

Comments from countries participating in SCOOP Task 3.2.5 (Dioxins)

In this annex comments from the participating countries are given on their own sampling procedures, analytical methodology, quality assurance and food consumption data on dioxins and related PCBs.

BELGIUM

Sampling Procedures

Human milk was collected in 1993 in the south of Belgium as described by the WHO project [1].
For dioxins in food sampling was done by the Ministry of Agriculture in cooperation with the Ministry of Health. In each region of Belgium a pooled sample was made with subsamples from three (1994-1997) or nine (1998-1999) different milk collector trucks (once or twice a year). In 1995 and 1996 half of the samples were milk products sampled in factories from all over the country (consumer milk, butter, cheese and milk powder).
For PCB's sampling was done by the Ministry of Health (Institute of Veterinarian Inspection and Food Inspection Service). Samples of meat were taken in slaughteries, samples of fish in fish markets and fish farms, samples of milk and milk products in retail, samples of eggs in egg packaging plants. The samples of meat were: 274 beef, 193 pork, 103 veal, 88 chicken (45 boiler and 43 broiler), 40 turkey, 10 rabbit, 10 ostrich, 8 horsemeat, and 6 mutton. The fish samples consisted of 52 marine fish and 102 freshwater fish. The milk and milk products consisted of 106 samples of butter and 36 samples of milk.

Analytical methodology and Quality Assurance

The method of analysis for dioxins in milk and milk products starts with freeze drying, then milling using Na2SO4 and silica, soxhlet extraction, purification using gel permeation chromatography, HPLC over a carbon column and clean up over alumina, detection with GC-HRMS (selective ion) and quantification according to the isotope dilution method. The laboratory is accredited since 1998 for this analysis and participated in former years in international ring tests.
Of the list of PCB's for which data were requested in this project, only PCB 118, PCB 138, PCB 153 and PCB180 were included in the method of analysis. The method of analysis for PCBs resembles CEN method prEN 1528-1à4 of 1996. The fat is extracted from the sample with appropriate solvent. The fat is then eliminated by partitioning between dimethylformamide and hexane. This extract is purified on a partially deactivated alumina column. The PCBs are determined by gas chromatography with ECD detector.

Food consumption data

In early 1997 a 7-day food record was done with 129 boys and 212 girls from 14 to 18 years old, selected from schools in the city of Ghent (Flanders). These are recent data of high quality. The study is, however, not representative for whole Begium as not all ages are included and as e.g. the consumption of butter is known to be significantly higher in the south of the country. Mean body weight was 59.7 kg.
Consumption data were combined with data on fat content (Belgian food composition table [2]). In this way grouping was done of all foods containing milk fat (all kinds of consumption milk, all kinds of cheese, yoghurt, ice cream, cream and butter). So grouping was done for consumption data and concentration data separately, on a fat basis, after which they were combined to obtain intake data. The mean intake of milkfat was distributed as follows: 24% due to milk and yoghurt, 54% due to cheese consumption, 14% for butter and 8% for ice cream.

Remarks and conclusions

Data on human milk show that dioxin and dioxin like PCB concentrations were high in comparison to other food, reflecting the accumulation by the mothers during their life.

A decreasing temporal trend can be observed for intake of dioxins from dairy foods. In 1999, the intake was two thirds of the intake of 1994.
Belgium also disposes of data of milk on farm level near to waste incinerators and other dioxin sources. Since 1990 a monitoring is carried out. These data cannot be used to estimate a dietary intake, but it can be mentioned here that in 1999, the milk of ten farms was withdrawn from the market because of a level of dioxins slightly exceeding the legal level of 5 pg TEQ/g fat (three sources of dioxin emission were identified: a waste incinerator in France near to the Belgian border, a waste incinerator near to Charleroi and a metal industry near to Ghent). Source directed measures have been taken. Levels are declining. Early 2000, the number of blocked farms decreased to four.
It can also be mentioned that, of course, Belgium has a lot of data of the incident in 1999. As this exposure was temporary, such data cannot be used in this study. In July 1999 pooled samples were collected for eggs. Although all 5 results were below 5 pg TEQ/g fat, an influence of the recent incident was suspected and so the results were not considered representative. Recently, an extensive random monitoring of dioxins has started especially for meat and fish and data will be available in the near future.
Data on PCBs are not adequate to allow a good estimate of TEQ intake, as the PCBs with the highest TEF values were not included in the analytical method used. Upper bound estimates of PCB TEQs could be large underestimates, as in case of “mean ND = LOD”, zero was still used for PCBs which were not included in the method of analysis (the seven indicator PCBs were analysed and not the set of dioxin-like PCBs). However, as most samples had concentrations below the LOD, upper bound estimates could also be large overestimates. We conclude that it was not possible to make an estimate of PCB TEQ intake.
Consumption data are not representative for whole Belgium. Cheese was the most important contributor of intake of milk fat for teenagers of Ghent.

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DENMARK

Dioxins and dioxin-like PCB have not been a part of regular national monitoring programs for contaminants in Denmark. Human milk was analysed for dioxins in 1986 and selected food items were analysed in 1987. It was then decided to follow the Danish human exposure mainly by monitoring the time trend in the levels of human milk. These analyses have been performed at the same intervals as the WHO's coordinated study on human milk. The last time was in 1993/94. Private institutions have on individual basis obtained results for dioxins in certain food items, and a recent study on cow's milk has been included in the database.

Sampling procedures

Food items: In 1987 a small number of samples were collected to give an overview of the contamination with dioxins in fatty food items (1). Cow's milk, yoghurt, butter and cheese were bought in retail stores in Copenhagen. Meat samples were collected at slaughterhouses. Fish samples of herring and cod liver were collected at Bornholm (Baltic Sea). In 1999 cow's milk samples were collected at bulk tanks. Samples within 10 regions were combined and the 10 pools which represent the whole of Denmark, were analysed for dioxins (2).

Human milk: Two surveys have been conducted. In 1986, samples from 6 regions were obtained. 10 individual samples and 1 pooled sample were analysed for dioxins (3). In 1993/94 human milk was collected from 8 regions in Denmark. 10 individual samples were analysed for both dioxins and PCB and 37 for PCB (4, 5).

Analytical methodology and Quality Assurance

All data were generated from generally accepted analytical methodologies for dioxin and dioxin-like PCB analyses. After fat extraction the cleanup included fat removal and fractionation on columns packed with different adsorbents such as silica, alumina, Florisil and carbon. The samples were spiked with carbon-13 isotope labelled standards for recovery and quantification purposes. The detection was performed on high resolution mass spectrometer after separation by gas chromatography, except for some of the mono- and di-ortho PCB analyses in which case EC-detectors were used after dual column gas chromatography.
The dioxin analyses of food items in 1987 were carried out at the Danish Veterinary and Food Administration, the former National Food Agency of Denmark. In addition to internal validation of the analytical procedures, standards were compared and calibrated with other international laboratories.

Analyses of a subset of the collected human milk samples from 1993/94 for both dioxins and PCB were conducted at RIVM, The Netherlands. Additional samples were analysed for PCB at the Danish Veterinary and Food Administration. In conjunction with the analyses the laboratories participated in interlaboratory comparison studies organised by WHO. The human milk analyses from 1987 were carried by the Danish Environmental Protection Agency. The laboratory is now a part of the National Environmental Research Institute. The laboratory participated in a proficiency test organised by the Nordic countries.

The recent cow's milk analyses from 1999 were arranged by the Danish Dairy Board and carried out by a commercial laboratory in Germany. No information on quality assurance was specified but it is believed to be comparable to current standards.

Food consumption data

The food consumption data supplied are derived from two national dietary surveys in 1985 (6) and in 1995 (7). In 1995 the method of the survey was a combination of a personal interview and selfadministered diet records. Dietary data were recorded for 7 consecutive days in supplied booklets with preprinted fixed answering categories supplemented with open categories. In the 1985 survey the dietary data were based on personal interviews covering a typical 1 month diet.
The data refer to males and females between 15 and 80 years old. In 1985 the number of persons participating was 2042 and in 1995 the number was 1837.

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FINLAND

The following report contains detailed information about the samples analysed by the National Public Health Institute, Kuopio, Finland.

Sampling procedures

Description of the samples
All the samples were of Finnish origin, with the exception of orange juices. As for cereals, it is un-clear whether they were domestic or imported. More detailed information about the sampling area and time is provided in the tables.

Sampling procedure
Cereals, vegetables and orange juices were collected from grocers, eggs from hen-houses, meat from slaughter houses and milk from dairies, all at random. Fish samples were collected from fish farms or from the main fishing areas. The sampling procedures were planned in co-opera-tion with the National Food Administration. Mother's milk sampling from two areas in Finland was carried out according to the instructions of WHO.

Sampling sites
Cereals: grocers, origin unknown
Vegetables: grocers, produced in different parts of Finland
Fish: fish farms, fishing areas
Dairy products: packaging dairies
Eggs: henhouses
Meat: slaughterhouses
Mother's milk: with the help of maternity clinics

Treatment of the samples prior to analysis
Cereals: homogenized and stored at room temperature
Vegetables: stored in refrigerator, homogenized prior to analysis
Fish: stored as frozen and homogenized prior to analysis
Dairy products: stored in refrigerator prior to analysis
Eggs: stored in refrigerator prior to analysis
Meat: stored as frozen and homogenized prior to analysis
Mother milk: stored as frozen until analysis

Analytical methodology and quality assurance
After homogenization the fat content was measured gravimetrically from the fatty samples. Thereafter the samples were extracted with Soxhlet and defatted on a silica column. PCDD/Fs and PCBs were fractionated on a carbon column and purified on an alumina column. After the analysis of mono- and di ortho PCBs, the non ortho PCBs were fractionated on a carbon column. The analysis was performed with HRGC/HRMS, using SIR and a 10 000 resolution. The detection limits for PCDD/Fs in the fatty samples ranged from 0.05 to 0.5 pg/g and in the whole weight samples from 0.005 to 0.05 pg/g, depending upon the food. As for PCBs, the detection limits in the fatty samples varied from 0.1 to 10 pg/g and in the whole weight samples from 0.005 to 10 pg/g, depending upon the food. The repeatability of the analytical results was below 10 %, and recoveries for internal standards were better than 60% for all congeners.

The laboratory is an accredited testing laboratory (No. T77) in Finland (SFS-EN 45001 and ISO/IEC Guide 25). The scope of accreditation covers PCDD/Fs, PCBs, and non ortho PCBs from soil, sediment, water, ash, serum, tissue and milk samples. The laboratory has parti-cipated in international quality control studies. Below are listed only those including serum, tissue or milk samples.

- PCDD/Fs in cow's milk samples organized by EU/BCR project in 1993
- WHO: second, third and fourth round of interlaboratory quality assessment studies on levels of PCBs, PCDDs and PCDFs in human milk and blood (the third round also included fish and cow milk samples)
- Second round of IUPAC/CFC/WG-HHEC project 650/80/94: Determination of toxicologically relevant chlorobiphenyls in two fish oils and an analytical solution.
- On going study: IUPAC/CFC/WG-HHEC project 650/90/97: Collaborative study on novel and conventional analytical techniques for the determination of toxicologically relevant PCB congeners in fish and human adipose tissue

In the third round of WHO interlaboratory quality assessment studies on levels of PCBs, PCDDs and PCDFs the laboratory was accepted for analysis of a) PCDD/Fs in fish, b) non ortho PCBs in blood, c) non ortho PCBs in fish, and other PCBs in fish. The report on the fourth round of WHO interlaboratory quality assessment studies has not been published. In the second round of IUPAC/CFC/WG-HHEC project 650/80/94 the laboratory was among the best in both categories within-lab repeatability and between-lab reproducibility on both fish oils and an analyte solution.

Food Consumption data

The food consumption data used in the intake calculations consist of the average consumption figures taken from the 1992 and 1997 Dietary Survey of Finnish Adults. The whole population, aged 25-64 years, was included (n=1861 in 1992, n=2862 in 1997). The intake calculations were based on the average consumptions of the foods and average concentrations of dioxins and furans. High intake or high consumers were not included (1997), because the dietary data consisted of a 24-hour recall; only one day per each study subject. Data for both men and women are given, but not for children. It is impossible to separate risk groups from a dietary material covering only one day. Infants were also excluded.

Conclusions

For eggs, Baltic herring, bovine and pork, dioxin concentration data from the beginning of the 1990's were used. The trend in dioxin concentrations has been downwards in the 1990's, and that is why the share of these above mentioned food groups may be somewhat overestimated in the intake calcu-lations of I-TEQ. On the other hand, there are no comparable PCB results available for the above food groups, so the intake calculations of PCB-TEQs and of total TEQs are clearly under-estimated.

According to Hallikainen and Vartiainen, the daily intake of PCDD/Fs was 95 pg /day (1.6 pg/bw/day) in 1995. In the present study dioxin intake was 48.3 pg/day (0.81 pg/bw/day), which means a decline of 49 % in the daily intake within five years.

In 1995, 33 % of the dioxin intake originated from milk and dairy products, and 63 % from fish and fish products (Hallikainen and Vartiainen, 1997). According to the present study, 79,3 % of the dioxin intake now comes from fish and fish products, 13 % from meat and eggs, 7.3 % from milk and milk products, and 0.4 % from fruits and vegetables (when congeners not detected were considered as 0 and not as LODs).

The time trend for PCDD/Fs in Finnish cow milk has been downwards. The concentrations have fallen by 88 % from 1991 to 1998. In 1991 the I-TEQ value for cow milk was 0.99 pg/g fat, in 1998 it was only 0.12 pg/g fat. In the case of rainbow trout the downward trend between 1993 and 1999 is not so clear (1.79 pg/g wet weight and 0.74 pg/g wet weight, respectively).

Although there are no intake calculations for breastfed infants, we have the time trend for PCDD/F and PCB concentrations between 1987 and 1994. In 1987, the I-TEQ concentration of PCDD/Fs was 20.1 pg/g fat, in 1994 it was 13.2 pg/g fat. For PCB-TEQ, the value was 28.4 pg/g fat in 1987 and 12.0 pg/g fat in 1994. This means a decline of 34 % in PCDD/F and of 58% in PCB. The difference in these declines is still being investigated.

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FRANCE

The following explanatory notes throw some light to the summary spreadsheets and relate to studies carried out in part by French administation (Ministry of Economy and Finances, Ministry of Agriculture and Fisheries and Ministry of Health) and another part by milk and meat industry.
All the samples reported in this SCOOP task were only analysed for the dioxins/furans. All samples were taken in the period 1998-1999.

Sampling procedures

Mothers' milk
This study was realised in 1998 and 1999 in French lactarium. Samples from 244 healthy women, younger than 35 years were collected. The sampling procedure was similar to those used in 1993 in the WHO program. The samples were collected in different regions of France, nevertheless, it is not possible to consider the subjects as representative of the French population of women feeding at the breast. The subjects were overrepresented in rural regions and had higher incomes than the general population of pregnant women.

Cows' milk
From April until June 1998, 149 semi-skimmed milk samples were collected by French veterinary service. Samples have been collected from bulk tanks of the milk industry in different regions of France (2 L by samples). Analysed of the 298 L of semi-skimmed milk correspond to more 15 millions L of collected milk. Samples were realised, when cattle were in pasture. Samples were packaged in plastic bottle or in cardboard and sent frozen to the laboratory for analysis.

Cow's milk products
126 milk products samples, include cream, cheese, butter and yoghurt were collected by French veterinary service.They were obtained randomly from various market of France regions. Final samples : 500 g were sent frozen to the analysis laboratory.

Fish
56 samples include all kinds of Sea fish like fresh salmon, smoked salmon, tuna, sardine, cod, hake, herring, etc… came from near the French coasts and have been collected by French veterinary service. They were obtained randomly from various market of France regions. Final samples : 200-1300 g were sent frozen to the analysis laboratory.The analyses were carried out on the muscle parts.

Sea foods (molluscs and crustaceans)
13 samples include Oysters, mussels, praw & crab have been collected by French veterinary service. They were obtained randomly and came from various market near the French coasts. Final samples : 200-700 g were sent frozen to the analysis laboratory.The analyses were carried out on the muscle parts.

Meat
50 samples, include beef, lamb, poultry and pork meat come from various areas of France. 6 samples out of 50 are collected from meat imported from the European Union (4 samples) and from the United States (2 samples). They were obtained randomly from various market of France regions. Final samples : 200-1400 g were sent frozen to the analysis laboratories.The analyses were carried out on the muscle parts. Analysis done for 24 samples by the laboratory ERGO (Germany) & by CARSO (France) for the others.

Meat products (pork and poultry delicatessen)
15 samples include poultry and pork meat. All the samples have been collected by French veterinary service. They were obtained randomly from various market of France regions. Final samples : 200-700 g were sent frozen to the analysis laboratory.

Offals
6 samples include majority bovine liver and have been collected by French veterinary service. They were obtained randomly from various market of France regions. Final samples : 400 g were sent frozen to the analysis laboratory.

Eggs
5 samples have been collected by French veterinary service in 5 differents regions in France
One sample was concocted by 6 eggs. Final samples : 200 g were sent frozen to the analysis laboratory.

Fruits
5 samples include orange, raisin and apple have been collected by French control service in differents regions in France. Final samples : 100 g were sent frozen to the analysis laboratory.

Cereals and cereals products
13 samples include cereals, bread, rice and pasta, have been collected by French control service in differents regions in France. Final samples : 200-700 g were sent frozen to the analysis laboratory.

Vegetables
35 samples including leafy, brassica, kale, spinach, potatoes and others vegetables come from several areas of France and have been collected by French control service. Two types of samples : 15 samples are collected in the vicinity of incinerators (around few kms) ; 17 samples are collected apart from incinerators. Samples are generally collected at market gardening or available for the consumer ; 2 samples at marketing come from an other region of France. Sampling has been done according to method used for the official control of pesticide residues in fruits and legumes. Treatment of samples : External leaves, soil and vegetable residues are removed. Final samples : 1000g were sent frozen to the analysis laboratory.

Analytical methodology and quality Assurance
The chemical analysis of 24 meat samples was performed at ERGO in Hamburg (Germany) and all the other analyses were carried out at CARSO (Lyon, France), which is one of the French national laboratories for the analysis of dioxins and furans in food. All samples were frozen, lyophilised and analysed according to validated procedures, including sample extraction, clean-up, and identification and quantification of the analytes by high resolution gas chromatography with high resolution mass spectrometry.
Both laboratories participated in interlaboratory trials of measurement of dioxins and PCBs in various biological materials as organised by WHO, ICES and IUPAC and have recognised expertise in the analysis of foods for dioxins and PCBs. The quality control criteria included the use of certified standards, continuous monitoring of blank samples and recovery qualification criteria.

Food consumption data
The food consumption data used in the intake calculations are derived from last national individuals food consumption survey, representative of French whole population (INCA, CREDOC, 1999). The methodology used was a precoded 7-d records and data refer to food as consumed with weight of food using photographs of foods items. This survey was realised in France in 1998/1999, next to 3003 consummers of to 2 years old and more (>75 years old) ; 1985 persons aged 15 and more and 1018 infants and children aged 3-14.

Body weights for the study populations are as follows:

Sex/Age group	n	Body weight Mean (kg/person)
Males & females 18 years old and more (>75 years old)	1339	67.1
Males & females 15-18 years old	135	59.7
Males & females 3-14 years old	1018	31.6

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GERMANY

General remarks

In Germany most data about dioxins in human milk and food were recorded by the food control laboratories of the federal Länder. Furthermore, three federal institutes belonging to the Federal Ministry for Agriculture submitted data on meat, milk and fish under the aspect of representativity.

The human milk data are collected in the data bank for residues in human milk and dioxins in other human tissues at the BgVV (Bundesinstitut für gesundheitlichen Verbraucherschutz und Veterinärmedizin, Federal Institute for Health Protection of Consumers and Veterinary Medicine).

In Annex 3, 1732 results for human milk and about 3000 for food have been summarized. It is obvious that not all the data are representative of Germany as a whole, but the overall number of samples analyzed permits a substantial overview of the dioxin levels in human milk and food. Data on food from 1995-1999 are of highest relevance and therefore they were used for the calculation of the present daily intake, but not all data reported could be included in the table. It was not always possible to derive representative levels of dioxin concentrations in a certain food for the calculation of the daily intake but rather to use expert assessments. At present, no information on the median and the 95th percentile can be derived from the data on food. Some reports showed the 95th percentile to be about the double of the mean for certain foods.

For human milk actual levels refer to the data from 1998.

To give an impression of the time course of levels data from 1986-1995 for food and 1986-1997 for human milk have been added in Annex 3, too. For that reason, all data must be comparable and therefore it is necessary that they were calculated with the same TEFs. Since the beginning of the nineties until now, I-TEFs have been generally used. Some of the data recorded before that period and using other TEFs were converted. Differences in the results for I-TEQ using upper or lower bound calculations are - as far it can be seen - in most cases neglectable (see Annex 3).

Data on dioxin-like PCBs are scarce and incomplete since some but not all dioxin-like PCBs from the list of the WHO report (van den Berg et al., 1998) were included. So these results which are not comparable with one another are not suitable as a basis for calculation of the daily intake of these compounds at present. Therefore, only data on PCDDs and PCDFs (dioxins) are used for this report.

Sampling procedures

Human milk

Analysis of dioxins in human milk from Germany has been performed since 1985 (Fürst, 1986). Data on 383 samples (including two pools) from 1987 were published in the Environmental Health Series by WHO (Yrjänheikki, 1989).

Two examinations within the framework of the WHO field study were performed by BgVV (Yrjänheikki, 1989, WHO, 1996) . Sampling was performed on the basis of the criteria established by WHO (Yrjänheikki, 1989).

The examinations reported by the federal Länder were conducted on the request of the mothers; i.e. sample selection was not subject to specific criteria but rather accidental.

The data shown in the table originate from different regions of Germany. They are representative of the background body burden of this population in Germany with dioxins and furans.

Milk and milk products

Analysis of dioxins in cow's milk has been performed since 1986 (Beck, 1987 b). As cow's milk and milk products are the main contributor to the human dioxin burden and are seen as a bio-indicator, samples from farms, dairies (consumer milk) and tanker lorries collecting milk from several farms (bulk milk) were analyzed in most cases. Due to seasonal changes in animal feeding stuffs, differences in dioxin levels in cow's milk amount to up to 25 % during the year (Fürst, 1998). The differences between certain regions are even higher (Ruoff, 1999, LUA Südbayern, 1998, Fürst, 1998). Contamination of cow's milk with dioxins by card-board containers was established in 1989 (Beck, 1990). After alterations of the procedure of bleeching, dioxin levels in cow's milk were not influenced by card board containers any more (Fürst, 1991). At the end of 1997, Malisch found increasing levels of dioxins in cow's milk (Malisch 1998 a) in Baden-Württemberg. During an intensive study, contaminated citrus pulp, a component of feeding stuff, was found to be the cause of elevated dioxin levels (Malisch 1998 a). Also in other federal Länder of Germany, an increase of dioxin levels caused by this feeding component was established (see Annex 3). For the calculation of the daily intake, these slightly elevated concentrations were not considered.

In general, consumer milk is most suitable for the calculation of the daily intake. But also milk from tanker lorries supplying dairies with cow's milk from many farms (bulk milk) of a certain region is acceptable. Since cow's milk from single farms reflects the background contamination of the farms and the animal feeding stuffs bought from elsewere, these samples should not be included in the calculation of the daily intake if high numbers of other samples are available. Data from samples which had been taken near industrial pollutants are excluded in order to ensure that the data reflect the normal background and not hot spots.

The data on milk and butter are, in general, similar. The results found by Ruoff (Ruoff, 1999) seem to be relatively low. Considering the limits of detection and that the I-TEQs were calculated with ND=0 for none detected congeners, these data are in agreement with the other data calculated with ND=1/2LOD.

For milk products (e. g. cheese), the number of samples analyzed is low and representative sampling was not performed. In contrast to milk, a high share of the milk products has been imported to Germany from other EU member states.

Meat and meat products

For animal fat, it is required to distinguish between different types of meat. For pork, the lowest levels were found. Differences between certain regions can be recognized for beef and poultry (Hecht, 1998). As sausages mainly contain pork their dioxin concentrations are similar (Hecht, 1998) but slightly higher than those of pork. This can be explained by the fact that sausage contains some of beef and liver and by the effect of smoking (Hecht, 1998).

As to meat and meat products, we did not include the levels reported by Hecht (Hecht, 1998), because this laboratory calculated I-TEQs with ND=0 for none detected congeners. If this is taken account, these data are in agreement with the other data calculated with ND=1/2LOD. Nevertheless, we assume that the quotient of dioxin concentrations in pork and sausage (1.4) is as a reasonable factor (Hecht, 1998) to estimate dioxin levels in sausage, i. e. on the basis of data on pork as no other data for sausages are available.

Because of low intakes and uncomplete consumption data, animal fat other than from pork, beef and poultry is not considered.

Eggs

For eggs, the dependence of the dioxin levels on the type of housing (cage, ground, field) has to be consired. Higher levels were found for eggs from hens which can take up dioxins from soil. Lower levels were established for eggs from hens housed in elevated wire cages. It seems that these dependencies decreased for recent samples (Fürst, 1993, LUA Südbayern, 1994, Malisch, 1994, CLUA Freiburg, 1997, SLUA Oldenburg, 1998). But the data base for this food item is inhomogenous. It has to be considered that about 90 % of eggs are layed from hens housed in wire cages.

Fish and fish products

It is problematic to generate representative data on dioxin levels in fish, as a lot of fish species and fishing grounds exist. In this connection, a recent representative study (Karl, 1999) including 184 samples of fish and fish products is of high importance. Sampling was based on the real intake according to the share of different species (FIZ, 1998) and fishing grounds. Because of great differences in the fat content of fish, levels on a whole weight basis were preferred.

Fruit and vegetable

All dioxin data on fruit and vegetable were combined.

For vegetable oil/margarine, no recent data for dioxin levels was available. Therefore levels from literature (Fürst, 1998) were used.

Analytical quality assurance

All laboratories involved participated in different interlaboratory control studies. The following matrices were offered:

eggs (Malisch, 1994); kale (Malisch, 1997); butter and milk (Malisch, 1998 b); human milk and blood as well as cow's milk (P. Fürst/Chemisches Landes- und Staatliches Veterinäruntersuchungsamt, Münster: Analytische Qualitätssicherung 1995); liver (Husseinpour/Ökometrik GmbH, Bayreuth: June and November 1996); human milk, blood, cow's milk and fish (first, second, third and fourth round of WHO interlaboratory control studies, Yrjänheikki, 1989 and 1991 and Nygren, 1993); fish oil (IUPAC project 650/80/94).

Food Consumption data

The Report on nutrition (Kübler, 1994) and its supplement (national food consumption survey, Kübler, 1995) served as a basis for representative data on intake of different fats (meat, meat products, milk, butter, milk products, eggs, vegetable oil/margarine, bread/bakery products, sweets). The amounts of fat were calculated on the basis of the mean intakes for male and female consumers of 25-50 years age. As different kinds of fat for meat were not considered in the studies, additional data were needed for meat and taken from Honikel and Hecht (Honikel, 1994, Hecht, 1998). For meat products (sausage), the procedure is already described above.

The kind of fat in bread/bakery products is not known. We asssume that 20 % is derived from butter, 70 % from vegetable oil/margarine and 10 % from eggs.

In sweets, we assume fat to consist of 50 % butter and of 50 % vegetable oil/margarine.

The group of fruit and vegetables includes their products, rice, flour, potatoes and marmelade.

For the consumption of fish and fish products, we used data from 1997 published in an annual report of the German Ministry for Agriculture (BMELF, 1998).

Daily intake and time trends

Human milk

The dioxin concentrations in human milk were calculated from the data received from the federal Länder and have been summarized in the table A for I-TEQs and PCDD/F-WHO-TEQs (WHO-TEQs):

Table A: Time course of PCDD/PCDF in human milk (pg I-TEQ/g fat and WHO-TEQ/g fat)

Sampling	No. of Samples	Remarks	Minimum		Mean Value		Median value		Maximum	
			I-TEQ	WHO-TEQ	I-TEQ	WHO-TEQ	I-TEQ	WHO-TEQ	I-TEQ	WHO-TEQ
1986-90	728	average	5.6		30.6	35.7	29.2	33.0	87.1	
1991	191	average	6.4	7.4	24.1	27.8	23.4	27.2	58.1	64.9
1992	171	average	4.9	5.7	21.0	24.0	20.6	24.1	47.8	53.8
1993	141	weighted average	4.1	4.2	18.9	22.0	20.9	24.2	37.6	
1994	90	average	6.1	7.1	17.5	20.4	17.2	20.1	43.9	50.3
1995	135	average	5.4	6.2	17.9	20.9	16.5	19.1	39.0	45.8
1996	81	average	4.9	5.7	14.0	16.2	13.7	16.1	30.5	35.4
1997	126	weighted average	6.0	7.0	11.6	13.5	12.4	14.4	28.7	32.8
1998	69	weighted average	4.7	5.3	12.9	14.9	12.0	14.2	28.9	31.9

The table shows PCDD/F-WHO-TEQs to be 16 % higher than I-TEQs.

The mean levels as well as the maximum levels of PCDD/PCDF in human milk samples have decreased by about 60 % between the late eighties (mean: 30.6 pg I-TEQ/g fat) and 1998 (mean: 12.9 pg I-TEQ/g fat). This decrease of the body burden is in the same range as the decrease of the dioxin intake and the decrease of dioxin concentrations in foods observed.

The regional distribution of the levels of the samples indicates that there are no or minor differences in the dioxin concentrations. As food intake accounts for the main proportion of the body burden of humans and food in Germany is uniformly distributed, no dependence of the levels on the geographic residence of mothers should be expected, which also includes the similarity of the congener pattern.

Breast feeding for a long time results in a body burden of infants with PCDD/PCDF which is distinctly higher as compared to the mothers (up to a factor of 2) (Mathar, 1998).

For the breast fed infant, an average daily dioxin intake of 57.0 pg I-TEQ/kg body weight (66.1 pg PCDD/F-WHO-TEQ/kg body weight) is calculated from the 1998 data [assumptions: age of the baby = 4 month; mean body weight = 6.5 kg (Brandt, 1979); mean daily milk intake = 821 ml (Wallgren, 1945); average fat content in human milk = 3.5 %) ; average daily intake of milk fat = 4.42 g/kg body weight].

Thus, the TDI derived by WHO is clearly exceeded during the short period of breast-feeding. Nevertheless, the WHO (WHO 1988 and 1998), the Deutsche Gesellschaft für Pharmakologie und Toxikologie (DGPT, 1992, German Society for Pharmacology and Toxicology) and the German National Breast-feeding Committee (1995) have stated that there are no indications of a health risk for a breast-fed infant from mother's milk contaminated with PCDD/PCDF in the concentrations found and recommend breast-feeding.

Food

The combination of consumption data and dioxin concentrations in foods results in an average daily intake of 51 pg I-TEQ per person and day for adults (see Table B). Relating this intake to the body weight (70 kg bw) leads to an average daily intake of 0.73 pg I-TEQ per kg bw and day.

Table B: Dietary intake of dioxins in Germany (1995-98)

	Consumption & Concentration based on	Mean Consumption in g per day	I-TEQ (ND=0.5LOD) pg/g	Daily Intake pg I-TEQ/day
Meat	fat	12.6		
pork	fat	6.08	0.29	1.8
beef	fat	4.23	0.66	2.8
poultry	fat	2.25	0.58	1.3
Meat products	fat	23.0	0.41	9.3
Milk	fat	7.7	0.58	4.4
Butter	fat	15.6	0.58	9.0
Milk products	fat	7.3	0.58	4.2
Eggs	fat	4.1	1.16	4.7
Vegetable oil & margarine	fat	17.9	0.02	0.4
Bread, baker's ware		9.7		
butter	fat	1.9	0.58	1.1
vegetable oil & margarine	fat	6.8	0.02	0.1
eggs	fat	1.0	1.16	1.1
Sweets	fat	2.9		
butter	fat	1.4	0.58	0.8
vegetable oil & margarine	fat	1.4	0.02	0.03
Fish	whole weight	19.9	0.29	5.8
Fruit/vegetables	whole weight	394	0.01	3.9
Sum				**50.9**

In comparison to the daily intake data of 1986-1991 (1.8-2.3 pg I-TEQ per kg bw and day, see Table C) this means a decrease of 60-70%. All further data about daily intakes compiled in the Table below are in full agreement and confirm this distinct decrease of the dioxin burden in the last 10 years. This includes data derived from consumption data combined with dioxin levels and on duplicate studies. The table also shows daily dioxin intakes for children to be distinctly higher than for adults. Similar results are published by Patandin (1999).

Table C: Daily intakes of dioxins (pg I-TEQ/(kg bw * d) from food in Germany since 1986

Year of Sampling	Method of calculation	Daily Intake	References
1986-89	Levels in foods (n=22) and consumption data	2.3	Beck, 1989
1987-90	Levels in foods (n=107) and consumption data	1.7-2.0	Fürst, 1990
1987-90	Levels in foods (n>=100) and consumption data	1.9	Beck, 1991a
1986-91	Levels in foods (n>500) and consumption data	1.8	BMU, 1993
1991-95	Levels in foods and consumption data	1.47	Wesp, 1996
1994	Duplicate study (6 female / 6 male)	0.79/0.91	Grün, 1995
1994-95	Duplicate study (7 female / 7 male)	0.72	Schrey, 1995
1993-96	Levels in foods (n=1414) and consumption data	0.88	Malisch, 1998a
1995	Duplicate study (7 female / 7 male children, age: 22 months – 5 years)	2.6	Schrey, 1996
1995	Levels in foods (several hundred) and consumption data	1.0	Fürst, 1997
1995-98	Levels in foods (several hundred) and consumption data	0.53	Karl, 1999
1995-98	Levels in foods (n≈3000) and consumption data	0.73	this report
1998	Duplicate study (21 female / 21 male children, age: 14 - 47 months)	1.61	Wittsiepe, 1999

When summarizing the data on daily intakes from food for this report, there are four groups which account for 10 or more % each of the body burden. These are

- milk and milk products (39 %, including milk fat from bread/bakery products and sweets)
- meat, meat products (30 %)
- fish and fish products (11 %)
- eggs (11 %, including bread/bakery products).

Fruits, vegetables, and vegetable oils (including vegetable oils/margarine in bread/bakery products and sweets) account for 9 % of the PCDD/F intake via food.

Large differences between PCDD/F levels in fish lead to a broader variation of the PCDD/F intakes from this food. For 1995, Fürst established a similar intake from fish (Fürst, 1997) as found by Karl (Karl, 1999) and used for this report. In contrast, the Freiburg data on fish (CLUA Freiburg, 1997) would lead to an dioxin intake from fish which is higher by 66% in comparison with the representative data according to the market share used by Karl (Karl, 1999). As in the Freiburg report a difference is made only between salt water and fresh water fish we preferred the data reported by Karl and included them in our calculations. Other data concerning fish (see Annex 3) were also not considered in the calculation of the daily intakes as most data relate to fish of minor importance.

The share of the daily dioxin intake from fish found to be 11 % at present (see also Fürst, 1997), is distinctly reduced in comparison to calculations based on levels found around 1990 (about 30 %, see Fürst, 1990, Beck, 1989 and 1991a, BMU, 1993). Decreases of dioxin levels in fish can be attributed to reduction of the mean age of fish and changes in the fishing grounds in addition to a decrease of environmental dioxin levels. Presumably non-representative sampling at the beginning of dioxin analysis in fish in Germany and recording of levels on a fat weight basis, which is problematic for fish (Ende, 1992, Fürst, 1998), prevent clear statements concerning the reasons for the strong decline. On the basis of the most representative data on fish for 1988-1991 reported by Ende (Ende, 1992), a decline of 59 % which is close to that found for other foods (see table below) can be calculated since that period.

The decreases of dioxin levels in other foods starting in the late eighties can only be estimated, because data from the late eighties are rare:

Table D: Decrease of dioxin levels in some foods

Food	I-TEQ, pg/g fat (before 1989)	I-TEQ, pg/g fat at present	Decrease %
Milk	1.8	0.58	68
Pork	0.4	0.29	28
Beef	3	0.66	78
Poultry	2.3	0.58	75

The data base for eggs is inhomogeneous. Therefore, a decline of dioxin levels is not proved, but an increase is unlikely.

Data on dioxin levels in fruits and vegetables are limited. As levels are very low and a multitude of different kinds of fruits and vegetables exist, it is not possible to make any clear statements. However, it is generally accepted that the decrease is substantial and at least in the range reported for other foods.

The effect of smoking on dioxin levels in meat, sausage and fish is unknown, because there are no systematic studies on this subject. Altogether, the additional dioxin contamination caused by smoking does not seem to be important (Hecht, 1998, Karl, 1999, Körner, 1990), although some high levels were reported for samples of the outer parts of smoked ham (Mayer, 1998). This can be explained by an inadequate technology of smoking in some cases, because the median levels in unsmoked and smoked ham are the same (Mayer, 1998).

Maximum residue levels

In 1993, a Joint Working Group on DIOXINS (federal and Länder authorities) submitted its second report (BMU, 1993 and Basler 1994). Concerning milk and dairy products, reference values and recommendations for action were given:

pg I-TEQ/g milk fat	Proposed action
<0.9	Desirable target; achievable in the long run only by measures to reduce the dioxin input into the environment.
>3.0	Identification of dioxin sources and initiation of measures to reduce input. Change of land use patterns recommended for affected farms, if emission-reducing measures are not feasible in the forseeable future or would not result in reduced contamination. Recommendation to stop direct supply of milk and dairy products to consumers.
>5.0	Ban on trade of contaminated milk and dairy products.

These recommendations were not included in any legal regulations.

In order to take protective measures with regard to the contamination by dioxins of certain food from Belgium in 1999, the EU Commission decided, in view of the absence of limits for dioxins, to use data on background levels as a reference for Member states. For Germany, the following reference levels were issued and compared with the mean levels derived in this report:

Food	Reference levels for a special case pg PCDD/F-WHO-TEQ/g fat	mean level pg I-TEQ/g fat
Eggs	5	1.16
Poultry	5	0.58
Pork	2	0.29
Milk	3	0.58
Beef	6	0.66

Although PCDD/F-WHO-TEQ are somewhat higher in comparison to I-TEQ, it is obvious that the reference levels are distinctly higher than the 95th percentile, which is about the double of the mean for most foods. When fixing the reference levels it was not considered that the contamination of certain foods from Belgium by dioxins coincided with a high contamination by PCBs resulting in an additional increase of WHO-TEQs.

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ITALY

Sampling procedures

Mothers' Milk. Human milk samples were collected according to the WHO protocol (1).

Milk. A large proportion of the milk consumed in Italy is imported. Consumer milk is by and large a pool of national and imported milk, though proportions in pools may vary considerably from a manufacturer to another. Samples analyzed are not of domestic origin and have been collected from tankers as soon as they arrived at the manufacturers.

Butter and Cheese. Samples were taken in foodstores and were Italian brands.

Meat and Eggs. Data produced mostly refer to imported products. In particular, the pork products are imported to a large extent and widely distributed throughout the Italian markets.

Fish and Molluscs. Samples of marine species with high commercial value were obtained in two sampling campaigns from the northern, central and southern areas of the Adriatic sea. All samples were analyzed by the Italian National Institute of Health.

Analytical Methodology and Quality Assurance

Most of the analyses were carried out at the Italian National Institute of Health by the Laboratory of Comparative Toxicology and Ecotoxicology. The Laboratory has participated in interlaboratory trials of analysis of dioxins and PCBs in various matrices and has recognised expertise in the analysis of foods for dioxins and PCBs. The analytical methodologies currently used and the quality control criteria, including the use of certified materials and continous monitoring of blank samples, have been published (2-7).

Food Consumption Data

Data here produced derived from the INN-CA 1994-96 food consumption survey (8).
The survey design was as follows.

- *Sample.* The total sample was composed of 1,200 households randomly selected from registry lists. They were representative of the four main geographical areas North West, North East, Centre and South. Within each area, households were selected taking into account the demographical size of municipalities. For each selected household (main), three substitutes were extracted in order to maintain the randomness. The number of individuals involved was over 3,000 ranging from 0 to 94 years, 48% males, 52% females.
- *Period.* The survey was carried out from October 1994 to February 1996. The households were divided into four groups in order to cover the four seasons.
- *Duration.* 7 days.
- *Measurement of food consumption.* Precise scales were provided in order to weigh food quantities (initial and final inventory, purchase, wastage, recipes and individual quantities whenever possible). Only for individual quantities, portion size was recorded instead of weighing, especially for outdoor consumption.
- *Ancillary information (explicative factors).* One household questionnaire, compiled by the person in charge of alimentation, to collect data on food-related activities, main purchase habits, changes in dietary habits, etc. One individual questionnaire about basic information such as age, gender, weight, height, marital status, education, job, health, special diets, life style habits. One individual questionnaire about attitudes towards foods rich in fats (Fishbein-Ajzen model).
- *Data check.* Completeness and data quality have been checked at single household level. Particularly, the food section validity was verified by considering that: food quantities had to be expressed as single food

items, raw and edible part only; therefore mixed dishes were split into single components according to the collected recipes "if prepared at home" or standard recipes "if consumed outside". In some cases conversion factors were applied; each food item was coded by utilising an ad hoc system, to identify single food items and aggregate into food groups; for each food item consumed at home, the weekly intake should be equal to the sum of individual consumptions plus wastage; for each ingredient in a household recipe, the initial raw quantity should be equal to the sum of individual consumptions plus wastage.

- *Post-selection of the subjects.* A subsample of 1978 individuals was selected by excluding outliers and suspected underreporting subjects. The selection was performed by calculating, for each individual, the daily energy requirement for an average life style and the corresponding daily energy intake (kcal) by the application of the Italian food composition table to the consumption quantities. The comparison of the two estimates provided the group of consumers assuming a habitual diet. The validity of the selection has been tested by calculating the ratio between the daily energy intake and the Basal Metabolic Rate (BMR) (FAO/WHO/UNU, 1985).
- *Numerical expression and food groups.* Food intakes are expressed in net weight (excluded left-over and wastage) of raw quantities of ingredients.

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NETHERLANDS

This information relates in most cases to studies carried out on behalf of the Ministry of Health, Welfare and Sports, the Ministry of Agriculture, Nature Management and Fisheries,. and the Ministry of Housing, Spatial Planning and the Environment.

Sampling procedures

Fats and oils. The selection of oils and fats was based on data from the Dutch Commodity Board Margarine, Fats and Oils (MVO) on the amounts of the main oils and fats used by the food industry in products for domestic consumption. In 1990-1991, the following fats and oils (number of different batches between brackets) were sampled in the food industry: palm oil, soybean oil (2x), coconut fat, palm oil, rape-seed oil, sunflower oil (2x) and

fish oil (5x). The selected types represented 98% of the total amount of oils and fats incorporated in products from the food industry, based on the consumption figures over the period 1987-1988 (1).
Incoming oils and fats in food industry are refined before use. To assure the representativity of resulting intake data, the food industry was asked to supply samples from the refined flows of oils and fats, directly prior to use in the manufacture of food products. This succeeded for most of the collected oils and fats. However, for some of the fish oils, only partly refined oils were collected. Therefore, a follow-up study was initiated to improve the representativity of the data and to study the influence of refining steps. To this end, a second sampling programme was carried out in the period September - December 1994, in which another twenty samples of both unrefined and refined batches of fish oils were analysed (2).

Consumer milk. The milk that reaches the majority of consumers in the Netherlands is produced by four (two since 1998) major manufacturers each of those having factories distributed over the country. Milk produced by these factories (further referred to as 'consumer milk') represent pooled samples of milk produced by dairy farms distributed all over the country. From time to time, Dutch consumer milk may even comprise supplies from abroad. Only minor fractions are bought directly at individual dairy farms. Using this information, it was chosen to collect samples of milk at super markets, retail outlets and milk factories, to collect representative data on levels of PCDDs, PCDFs and non-ortho planar PCBs in consumer milk. Two national composite samples of consumer milk have been prepared in the spring of 1991. To this end, four packages of cartoned milk of 1 liter each were bought at local stores on the same in areas near Groningen (north), Weert (south), Delft (west) and Utrecht (centre). By mixing equal weight amounts of the four regional samples, a national representative pooled sample was obtained. The same procedure was repeated one month later.
A follow-up to investigate levels in consumer milk over a longer period of time have been carried out in the period October 1992 - September 1993. A similar sampling campaign is carried out since October 1997 (is at present still ongoing). In these monitoring programs, cartons of whole milk are collected at regular intervals (at least one sample per week) from the major manufacturers in several regions distributed over the country. In the 1992-1993 study, 'quarterly averaged' samples were prepared from four manufacturers located in the north, east, west and south of the Netherlands by mixing equal weight amounts of samples taken over a period of a quarter of a year. Finally, eleven quarterly averaged samples were taken into analysis (2). In the on-going programme, 'monthly averaged' samples are prepared from the four (since 1999 two) major manufacturers in the country by mixing equal weight amounts of samples taken over a period of one month.

Farm milk. Additional information on local variations in levels in cow's milk has been obtained in a monitoring programme (3). The programme included the measurement of dioxin levels in samples of cow's milk collected from storage containers at selected dairy farms in the neighbourhood of waste incinerators and a metal reclamation plant. The main purpose of this programme was to check dioxin levels in suspected areas in the framework of the Commodities Act Dioxins in Milk, active as of July 1989. If the standard of 6 pg (i)-TEQ/g of fat is exceeded, milk from that area is collected and destroyed. Since 1989, hundreds of samples of cow's milk have been collected around dioxin sources in the Netherlands. In 1989, this programme also included samples taken from dairy farms in 'rural areas', i.e. farms remote from urban/industrial areas. Initially, samples representing the daily production of each selected farm were analysed. Due to observed day-to-day variations it was decided late 1989 to prepare composite samples ('monthly averaged samples') of 150 ml each by mixing six samples of 25 ml taken from the same farm at regular time intervals over a period of one month (3).

Animal fat and liver. For the category with one type of animal fat, both fat and liver samples were collected in slaughterhouses in four different regions (North, West, East and South) in the Netherlands. At regular time intervals in the period July-September 1990, samples of liver and fat were collected in each region from ten animals of the following species: cow, pig, horse, sheep, goat and chicken. During sampling, amounts of at least 10 g of subcutaneous neck or intestinal fat (or tail fat of chicken) and 250 g of liver were collected. Only animals intended for domestic consumption were selected. Next, two independent regionally pooled samples were made by mixing equal weight amounts of five of the ten samples for the first (”A”) and the other five for the second regional sample (”B”). This resulted in eight regional composite samples (four regions, two composites for each region, five individual samples pooled to one regional sample). Finally, national composite samples were made by mixing equal weight amounts of one of the two regional samples from each region (2).

Cereals. Samples of wheat flour, wheat and rye were collected at the three largest flour mills in the Netherlands in the fall of 1991. Next, composite samples of wheat flour, wheat and rye were prepared each by mixing of the three samples collected (2).

Butter, cheese, meat products, nuts, eggs, fish and game. Categories ‘butter and cheese’, ‘meat products’, ‘nuts’, ‘eggs’, ‘fish’ and ‘game’ were sampled using a proportional technique. These samples were prepared from a mixture of different food products, with each item added in weight proportional to its average consumption, as determined in the Dutch National Food Consumption Survey, held in 1987-1988 (4). The selection of food items to be mixed had to cover at least 95% of the intake of the respective category according to the Dutch National Food Consumption Survey. The items themselves were collected in four different regions in the Netherlands. In each region, two different inspectors of a Regional Inspectorate for Health Protection collected independently from each other the complete set of requested food items at stores of their own choice. Similar to the category of animal fats, eight regional samples and two nation-wide composite samples were finally obtained (2).
A similar sampling strategy is used in the most recent food study, which is started in 1998. A full report on the findings is expected in the spring of 2000. In this study, various food products from the Dutch food supply were collected at super markets or other outlets in five different regions of the Netherlandsin the month March 1999. As for the 1990-1991 study, a database of the Dutch National Food Consumption Survey was used for the selection of the food products, and to aggregate the various food products into nation wide composites (in Annex 3 referred to as 'mixed-DNFCS') for each of the various food groups (eighteen in total). For this study the database of the third Dutch National Food ConsumptionSurvey held in 1997-1998 (DNFCS 1997-1998) was used.

Curly kale. In the design of the food study carried out in 1990-1991, it was assumed that 98% of the human exposure occurs through consumption of foods from animal origin (5). Therefore it was decided to exclude the category of vegetables from the sampling programme. However, to allow a rough estimate of the additional exposure through the consumption of vegetables, the results from a separate study on dioxin levels in curly kale (*Brassica oleracea var. acephala*) have been included.
Curly kale is a crop grown in the open field with a large and fatty leaf surface and demands, compared to other leafy vegetables, a relatively long growth season (fall and winter). Fourteen samples of curly kale were collected from allotments in the neighbourhood of two municipal waste incinerators (Lickebaert area, Duiven), a metal reclamation plant (Culemborg) and two reference locations (Bergambacht and Texel) at the end of the growing season in February 1991. The levels of dioxins and furans in the samples were subsequently analysed.

Duplicate diets. The analytical programme consisted of samples of 24-hour duplicate diets collected by adults in the period January-March 1978, in October 1984 and March 1985, and in March and October 1994. The samples were stored in freeze-dried state at -20°C until analysis. Information on original weights and the percentage of dry weight after lyophilization was available. In addition, personal characteristics (e.g. age, length, body weight, sex) of the consumer were known. The study design was optimized to acquire information on the temporal trend in the average dietary intake expressed per kg body weight per day. In order to minimize the number of nondetects, it was chosen to perform the analyses on composite samples. These composites were prepared by mixing aliquots of the freeze-dried duplicate diets of about 10 (25 for 1978) individuals in each pool. Of each duplicate, an equal weight fraction was aggregated into the respective pool. Finally, each composite (i.e. 4 samples from 1978, ten samples from 1984-1985 and 10 samples from 1994) was subsequently analysed on the levels of PCDDs, PCDFs and an extensive selection of PCBs (2).

Human Milk. The human milk data refer to studies performed by the RIVM and as reported by Koopman-Esseboom and coworkers (6). The Koopman-Esseboom study included 195 individual samples of mothers recruited between June 1990 and June 1992. The human milk surveys performed by RIVM are performed at five years intervals to study trends in human exposure to polychlorinated organic compounds (7, 8). The two latest surveys also included congener-specific determinations of the PCDDs and PCDFs (pooled samples in 1988 and individual samples in 1993) and dioxin-like PCBs (individual samples in 1993). In September 1998, the samples for the most recent RIVM campaign were collected. Results will become available in the summer-fall of 2000.

Analytical methodology and Quality Assurance

The analyses were carried out at the Laboratory for Organic-analytical Chemistry of the RIVM, Bilthoven, or at the State Institute for Quality Control of Agricultural Products (RIKILT) in Wageningen (Koopman-Esseboom study). The analytical methodologies of both laboratories have been published (9-12).

The laboratories have participated in inter-laboratory trials of measurement of dioxins and PCBs in biological tissues organised by the WHO, EU-SM&T, IUPAC and QUASIMEME and have recognised expertise in the analysis of foods for dioxins and PCBs.

Where available, reference materials are used and the agreement achieved is between specified ranges between actual and measured concentrations for individual congeners. Based on a number of studies, the coefficients of variation for the determination of TEQs were approximately 100% for samples of vegetable oils and fats and approximately 5% for the other foods including human milk. For individual congeners, coefficients of variation were around 20% for levels above 1 pg/g fat, and less than 50% for levels between 0.1 and 1 pg/g fat. Below 0.1 pg/g fat, higher variations should be taken into account (2).

Food consumption data

For the selection of foods and the calculation of dietary intakes, the databases of the Dutch National Food Consumption Survey (DNFCS) have been used. The surveys have been carried out and have been described elsewhere (4, 13, 14). Briefly, 2203 (2475 in 1992, and 2564 in 1997-1998) households participated resulting in a sample of 5898 (6218 in 1992, and 5958 in 1997-1998) subjects. Food consumption was assessed by a 2-day dietary record method, equally distributed over the seven days of the week and over a whole year. For each subject, data on age, sex, body weight and a series of other characteristics were available. The population group ranged from 1 to 85 years in age. For each person, the quantities of various ingested food items over the day were recorded. Of each food product, a comprehensive description of the food items, including percentage total fat, was available from the Netherlands Nutrient databank (15, 16). The average body weight for the total population of the DNFCS held in 1987-1988, 1992 and 1997-1998 were 61.87, 63.05 and 65.48 kg, respectively.

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NORWAY

Sampling procedures

Most of the information included in this report relates to studies initiated by the Norwegian Food Control Authority (SNT). The analyses of dioxins and dioxin-like PCBs were carried out at the National Institute of Public Health, the Norwegian College of Veterinary Medicine and the Norwegian Institute for Air Research. Some of the data are collected in collaboration with other institutes such as the Norwegian Institute for Water Research (NIVA) and The Directorate of Fisheries.

The Norwegian Pollution Control Authority (SFT) has since the middle of the 1980's carried out monitoring programs in industrially contaminated areas. Because of industrial emissions to some fjords and harbours, fish and shellfish are heavily contaminated with dioxins, PCBs, PAH and for heavy metals. The Norwegian Food Control Authority recommends restrictions on seafood consumption and bans sale of seafood from certain contaminated areas. Data obtained on levels of dioxins and dioxin-like PCBs in biota from these special monitoring programs are not included in this report since they are not considered to be representative for food on the market, but they can be made available if needed.

Data used in this report are from areas considered as uncontaminated. The samples are considered to be representative for foods on the market.

Eggs and Milk products

The Local Food Control Authorities in Oslo, Trondheim and Stavanger collected samples of eggs and butter at retail outlets. Each egg and butter sample contained eggs or butter from 10 different packages, respectively.

All estimates of intake from milk products are based on the levels of dioxins and PCBs found in butter since no data from non-*ortho* PCB in milk were available. This assumption is justified by comparing the analytical results of dioxins and other PCBs in milk and butter. According to expectation the results are very similar when expressed on a fat weight basis.

Margarine based on marine oils

In 1989, two pooled samples from the two largest producers of hard margarine were collected at retail outlets by the Local Food Control Authorities in Oslo and Trondheim. At that time it was common to use marine oils as ingredients in margarine. Today all margarins sold to the consumers are based on vegetable oils, but marine oils are still to a certain extent used in food production.

Fish

Samples of commercially important fish species were caught in the coastal waters of Northern Norway during 1994. The fish samples of muscle, liver or roe were collected from commercial catches delivered to local fishing plants, and from research catches on board the research vessel «Oscar Sund», Department of Fisheries an Natural Science, Bodø College. The samples of salmon were collected at fish farms. Most of the fish samples consisted of 25 individuals. The samples were packaged, frozen and transported to the laboratories. Special precautions were taken to avoid contamination of the fish samples.

The Directorate of Fisheries collected the samples of cod muscle in 1989.

Crab

The Norwegian Institute for Water Research (NIVA) caught 10-20 male crabs considered representative of commercial fishing sites in September-November 1996.

Cod liver oil

In 1996, three samples from the largest producers of cod liver oil were collected at retail outlets by the Local Food Control Authorities in Oslo. The pooled samples consisted of oil from 5 different bottles.

These cod liver oils had gone through a cleaning process for removing organic contaminants. The producers of cod liver oil did not have such cleaning procedures for organic contaminants before 1988-90, and dioxins levels up to 16 TEQ (pg/g) were at that time found in products. Results from 1994 show that the levels of dioxins have declined to 0.53 TEQ. This illustrates that it is possible to clean oils that are contaminated with organic contaminants.

Meat

The meat analyses were performed on fat and not on meat muscle. The pooled samples of meat fat were taken at slaughterhouses and each sample consisted of fat from at least 10 individuals. The local Food Control Authorities in some of the main cities of Norway (Oslo, Trondheim and Stavanger) collected the samples from cattle and pigs, while the sheep samples were taken by the slaughterhouses in Stavanger, Tynset and Gol.

Human Milk

Study from 1991 (Johansen et al. 1994). A total of 28 Norwegian mothers (26.2 $\pm$ 2,7 years of age) participated in the study. The milk samples were analysed individually. The women were giving birth to their first child during the period April-July 1991 at the City Hospital of Oslo, Ullevål Sykehus. They had lived in the Oslo area during the preceding 3 years, immigrants to Norway were excluded. All samples were taken from healthy donors with normal and healthy babies. Apart from these selection criteria, mothers were selected at random. Samples of colostrum and milk (10-20 ml) were obtained 3-5 days postpartum. The milk was expressed manually or by a furnished

breast pump that had been tested for adsorption and contamination. The milk samples were immediately frozen in glass bottles (cleaned with ethanol and hexane) and kept frozen at -20°C until analysed. A questionnaire including background data on mothers and child, such as sex, length, and weight of the infant, and age, weight, height, smoking habits, occupation, dietary habits, and health status of the mother was completed by each donor and made it possible to ensure that mother/infant pairs agreed with the selection criteria used. Such data would also reveal any «extreme» mother/infant pairs in the sample.
Study from 1992/1993 (Becher et al. 1995). Milk from mothers living for at least 5 years in the three different areas was collected and pooled (10 mothers per pool). The areas comprised a coastal non-industrialised, a rural, and an industrial/urban area. The selection criteria for mothers developed by WHO/EURO were used. Each mother had given birth to her first child and had a single birth. Both mother and child were apparently healthy, and the pregnancy had been normal. The sampling was carried out between 2 weeks and 5 months after delivery. Only exclusively breast-feeding mothers were included. Apart from these criteria, mothers were selected at random, and participation was voluntary. The milk was expressed by a furnished breast pump that had been tested for lack of adsorption and contamination.

A volume of about 60 ml was collected within 24 h. The milk samples were immediately frozen in glass bottles free of contamination and kept -20°C until pooling. For pooling, milk samples from each area were thoroughly homogenised by shaking in an incubator at 37°C. Then 50 ml of human milk from each of 10 mothers was mixed to give a single pooled sample for analysis of PCDDs and PCDFs, non-*ortho* PCBs, and other PCBs and stored at -20 until analysed. Laboratory reagent equipment blanks were analysed prior to series of samples to test for presence of background contamination. Detection limits for GC-ECD were between 5 and 20 pg/g milk depending on the congener, 3-15 fg/g milk for GC-MS of PCDDs/PCDFs, and 1-7 fg/g milk for non-*ortho* PCBs.

Analytical methodology and Quality Assurance

The analyses of dioxins and dioxin-like PCBs were carried out at the National Institute of Public Health, the Norwegian College of Veterinary Medicine and the Norwegian Institute for Air Research.
Participation in an interlaboratory analytical quality assurance test organised by Swedish environmental Protection Agency (SEPA) confirmed good analytical quality for determination of non-*ortho*-substituted PCBs in fish oil samples. The laboratories had participated successfully in international quality control studies for analysis of major PCB congeners in human milk organised by WHO/UNEP in 1982 an 1992 (Norwegian College of Veterinary Medicine, Oslo) and the analysis of PCDDs and PCDFs in human milk organised by WHO/EURO in 1993 (National Institute of Public Health, Oslo).

Toxic Equivalency Factors

For the human milk studies levels expressed in 2,3,7,8-TCDD toxic equivalent (TEQs) were calculated by using the international equivalency factors (ITEQs) for PCDDs and PCDFs (NATO/CCMS,1988) and the WHO TEFs for dioxin-like PCBs (Ahlborg et al., 1994). For the different food items TEQs for dioxins are calculated according to the Nordic model (Ahlborg et al., 1988), while the WHO model (Ahlborg et al., 1994) was used for PCBs. Generally a reporting limit is applied which is the limit of determination (LOD) of the analytical method (except the human milk study from 1991 were the reporting limit is 0.5 LOD).

Food consumption data

The Norwegian consumption data are from the national dietary survey NORKOST 1997 (The National Council on Nutrition and Physical Activity, 1999), which includes 2672 persons in the age of 16 to 79 years. The method used in the NORKOST surveys is a quantitative food frequency questionnaire. The results from the survey describe *the usual diet* among the participants.
There is a tendency that surveys using food frequency questionnaires overestimate the food consumption in relation to food records measures. The average energy intake among men aged 16 to 19 years who participated in NORKOST 1993/94 was above the reference values for boys aged 15 to 18 years. This may indicate that this age

group overestimates their consumption to some degree. However, the average energy intake among men in the age group 30 to 79 years old were within the reference values. Female participants reported energy intakes below the reference values which indicates that the women may *under*estimate their consumption (Johansson et al. 1997).

The statistical values of food consumption are based on *all* participants, i.e. both consumers and non-consumers of the foods. This means that the intake estimates will be spread also on those participants who do not have consumed the particular food. This will lead to a lower intake estimate than if only the consumers were to be considered.

In the food composition data base similar types of certain foods have been aggregated into one food code. For instance, plaice is aggregated into a food code that also consists of other kinds of fish. In the data base a «recipe» is connected to such a food code with information about the assumed percentage of each fish type. This information was used when calculating the amount of plaice that was consumed by the participants.

Since only the PCB and dioxins content in meat-, margarine- and butter fat have been analysed and not in the products as such, the consumption data refer to fat coming from meat, milk, butter and margarine. Data from the food composition database for the fat content in these foods have been used. The consumption of milk fat includes fat from milk, cream, cheese and ice cream.

The contribution from cakes and biscuits to the total intake of different kinds of fat and eggs, were calculated by using standard recipes laid down in the food composition data base. Recipes from this data base were also used when calculating the contribution from fish products made of cod to the total intake of cod.

Some of the questions asked in NORKOST were about the consumption of meat dishes. The participants were not asked to specify the kind of meat used in these dishes. When calculating the consumption of various meats it was assumed that certain fractions consisted of pork, cattle and sheep respectively.

The Norwegian intake estimates are subject to some uncertainties. There were few analytical data available. As a consequence of this the intake calculation did not cover all sources to the total dietary intake of PCB and dioxins. There were also difficulties in finding data for the consumption of specific foods. Therefore assumptions had to be made about the consumption of some of the relevant foods.

It should also be notified that almost all margarine used in Norway nowadays consists of vegetable fat. As mentioned earlier the analytical data for the content of PCB and dioxins in margarine are from the time when this product still contained fish oils. This may have resulted in estimated intakes of the substances which are higher than the actual levels.

The average body weights for the human material are as follows:

Sex/age group	n	Body weight (mean)
Males 16-79 years old	1246	80.6 kg
Females 16-79 years old	1319	66.3 kg

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SWEDEN

The following explanatory notes throw some light to the summary spreadsheets and relate to studies carried out in part on behalf of the Swedish Environmental Protection Agency (EPA) and in part at the National Food Administration (NFA).
Regular environmental monitoring of persistent organic pollutants is carried out primarily, where possible, within the framework of the national environmental monitoring programme 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.
The NFA gives priority to surveillance of foods of animal origin and vegetables and thus provides some data on food items to supplement the Swedish EPA programme.

Sampling procedures

Cows' milk. Until 1998 milk samples were collected either from individual farms or from retail outlets from time to time and analysed. Since 1998 samples have been collected from bulk tanks. Composite samples are prepared regionwise and frozen until analysis. In 1988-1990 samples were only analysed for the dioxins/furans.

Fish. Samples of herring have been monitored by the National Environmental Protection Agency for many years through a number of laboratories. Other fishes analysed but not on a regular basis include salmon, whitefish, eel etc. They were obtained randomly from the fish market or through professional fishermen. The analyses were carried out on the muscle parts.

Mothers' milk. Human milk surveys have been carried out by Norén *et al* between 1972 - 1992 in pooled samples (1) and by Atuma *et al* at the National Food Administration, 1994 - 1998 (2,5). The NFA's survey for PCDD/Fs and the dioxin-like PCBs included 10 and 63 individual samples in 1994 and 1997/1998 respectively.

Meat. The meat samples analysed for the dioxin-like substances were mainly from pigs, cows, sheep and chicken and were very few in number. These were carried out in 1989 and just recently (1998, 1999) more samples have been analysed for both PCBs and dioxins.

Eggs. Eggs have been analysed only in two occasions, 1993 and 1999. They were obtained from different food stores and represented different producers. Samples from 1993 comprised of 84 eggs subdivided into 7 pools. In 1999 there were 4 pooled samples consisting of 8 eggs each.

Market basket survey. Mixtures of different food products, comprising of different fish type, meat products, eggs, milk and milk products were prepared in various categories, with each item added in weight proportional to the average consumption. The items were collected mainly from four locations in Sweden (Gothenburg, Uppsala, Malmö and Sundsvall).

Analytical methodology and Quality Assurance

Most of the analyses were carried out at the Department of Environmental Chemistry, University of Umeå, Institute for Applied Environmental Research (ITM), University of Stockholm, Department of Medical Biochemistry and Biophysics, Karolinska Institute, Stockholm and National Food Administration, Uppsala. Some of the dioxin analyses were carried out at RIVM, The Netherlands and Dr. Wessling Laboratory in Altenberge. All samples were analysed according to validated procedures, including sample extraction, clean-up, separation on silica gel or alumina column, identification and quantification of the analytes by gas chromatography with ecd or high resolution mass spectrometry.

The laboratories involved have 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 included the use of certified standards, continuous monitoring of blank samples and recovery qualification criteria of 50-150% for the dioxins.

Food consumption data

The food consumption data used in the intake calculations are derived from the national dietary survey carried out in 1997-98 (Riksmaten).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 consumption data for individual fish species are derived from a food frequency questionnaire included in the survey covering consumption during the previous year. Standard portions have been used to estimate the average daily fish consumption. Analytical data are available for a few fish species, and these data have been matched with the appropriate fish category in the questionnaire.

Body weights for the study populations are as follows:

	Riksmaten 1997-98
Males	80.8
Females	66.6
Average	73.7

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UNITED KINGDOM

This information relates only to those studies carried out on behalf of the Ministry of Agriculture, Fisheries and Food (MAFF). Other occurrence data have been provided by the Department of Agriculture in Northern Ireland (DANI) and the University of Lancaster.

Sampling Procedures and Sample Treatment

Total Diet Study (TDS). Samples consist of retail food products, prepared as for consumption, and then combined into composite samples in amounts reflecting their relative importance in the typical UK diet in a particular year. Each composite sample represents a defined food group. 1982 and 1992 TDS samples of for each of the food groups included were collected from 24 locations in the UK for each year and pooled into single samples for analysis. All TDS samples are stored under stable conditions.

Retail cows' milk. Samples were collected from retail outlets and doorstep deliveries. Milk contained variously in glass bottles or in paperboard cartons have been studied. Samples were frozen for transportation and, on arrival, were pooled and homogenised to produce a single bulk sample for each region. Subsequent treatment as given above.

Farmed trout. Samples of edible trout flesh were obtained during the period October-December 1995, from trout farms across England and Wales by Fish Health Inspectors. Each sample consisted of several fillets of muscle taken from different fish of similar age and size at each location. The samples were packaged, deep-frozen and transported to the laboratory. Samples were not prepared as for consumption prior to analysis. Fish tissue was thawed, homogenised and subdivided into smaller portions, which were weighed, re-frozen and freeze dried to constant pressure. Moisture loss was determined gravimetrically. The portions were recombined, ground together to ensure thorough mixing, and stored in tightly-capped glass containers. An aliquot of the powder was taken for analysis and another for fat determination, whilst the remainder was stored at -20°C.

Marine fish. The sampling plan for marine fish was designed to provide a range of species and ports, or countries, of landing. Samples were also obtained at different times of the year to cover any seasonal variations. Primary samples were taken from a major fish market and consisted of a minimum of 3 whole fish or, in the case of large species such as cod or haddock, fillets taken from at least 3 fish. Samples made up of whole fish were filleted, skinned and homogenised before being subdivided into smaller portions. Where samples arrived as large fillets, each fillet was skinned, sub-sampled and homogenised together before subdivision. Fish finger samples were taken from retail outlets and were thawed, removed from all packaging and homogenised (complete with breadcrumb coating) before subdivision. The smaller portions were then weighed, frozen and freeze dried to constant pressure. Moisture loss was determined gravimetrically. The portions were recombined, homogenised and stored in tightly capped glass containers. An aliquot of the powder was taken for analysis, whilst the remainder was stored at -20°C.

Fish oil dietary supplements. Samples were purchased from shops or supplied by the manufacturer and/or by the Medicines Control Agency. The survey covered the leading brands on the market only and was not a comprehensive survey of all brands available. Samples included pure cod liver oils, halibut liver oils and fish body oils in bottles and/or in capsules and bottled mixtures of cod liver oil enriched with fish oil and cod liver oil with syrup.

Cows' milk from individual farms. Milk samples were taken from individual cows or more usually from the bulk tanks of dairy farms after thorough mixing of the contents. The milk was placed in chemically clean glass bottles provided by the laboratory and frozen before despatch by commercial carrier. Frozen milk was thawed slowly and subdivided into smaller portions, which were weighed, re-frozen and freeze-dried to constant pressure. Moisture loss was determined gravimetrically. The portions were recombined, homogenised and stored in tightly capped glass containers. An aliquot of the powder was taken for analysis, whilst the remainder was stored at -20°C.

Analytical methodology and AQA

The analyses undertaken on behalf of MAFF were carried out at the Central Science Laboratory, Food Science Laboratory, Norwich. The analytical methodology currently used for the determining dioxin and PCB concentrations in food has been published (1).
The laboratory has participated in inter-laboratory trials of measurement of dioxins and PCBs in human milk and human blood organised by the WHO and has recognised expertise in the analysis of foods for dioxins and PCBs. Generally a reporting limit is applied which is the limit of determination (LOD) of the analytical method. Where the target LOD is not achieved, the reporting limit is the prevailing limit of determination, set by the level and variability in the analytical batch blanks, rather than instrumental sensitivity. Analytical data are assessed for compliance with published acceptance criteria (2).
Where available, reference materials are used and the agreement achieved is between specified ranges between actual and measured concentrations for individual congeners. Based on a number of studies, the coefficients of variation for the analyses were approximately 10% for dioxins and non-*ortho*-PCBs and up to 5% for *ortho*-PCBs.

Food Consumption data

Adults The 1986/7 British Adults Survey was a seven day weighed diary study of 2197 adults aged between 16 and 65 chosen to be representative of the general population and living in private households. The data have been averaged over 7 days for consumption estimates. Mean and 97.5th percentile consumption figures were given by consumer. Mean and 95th percentile consumption figures by population were later supplied following agreement by participants that only population exposure estimates would be included in the report. Consumption data are generally considered to be representative of an average UK adult but the figures are not targeted towards particular ethnic groups (3). The average bodyweight of the survey population was 70.1kg.

Schoolchildren The 1986/7 Schoolchildren Study was also a 7 day weighed dietary survey of 3367 schoolchildren [aged 10/11 (2071) and 14/15 (1296) year old] from Local Authority schools where school meals were provided. All food and drink consumed in the home was weighed and recorded in a diary by the children, while food outside the home, where weighing was not possible, were recorded in a pocket notebook by each child. The food was then traced by fieldworkers at a later date. Weights of schoolchildren were not measured, so that average values are used to express consumption or intake data by bodyweight. The data cannot be considered as truly representative of a population of schoolchildren in the UK because (i) there was over-sampling of Scottish children (aged 10/11) and (ii) over-sampling has occurred of children from lower class families. For this reason such figures should be viewed with some caution (4). The average bodyweight of the survey population was 43.4kg.

Toddlers. The 1992/3 Toddler Survey was a 4-day weighed diary study of 1675 children aged 1.5 to 4.5 years. Average bodyweights were 12.3 kg for toddlers aged 1.5 to 2.5 years, 14.6 kg for toddlers aged 2.5 to 3.5 years and 16.5 kg for toddlers aged 3.5 to 4.5 years. The overall bodyweight of the study population was 14.4kg (5).

Breast fed infants. A study which tracked the consumption of human milk by 48 infants over an eight month period was used to give estimates of the mean consumption of human milk by nursing infants between 2 and 10 months of age (6).

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Annex 3: Occurrence data for dioxins and related PCBs (concentrations in pg/g) in different food products reported by the participating countries

ID	Food	Country	rep/sel	Origin	Description	Year	No. of Samples #coll.	/pool	#anal	Fat %	basis	TEQ pg/g PCDD/F	PCB	Handling of nd's	PCB selection
	cereals / cereal products														
173	bread food group	UK	rep	Whole of UK	total diet study	1982	24	24	1	1.9	fat	1.28	1.00	nd=LOD	All_PCBs
174	bread food group	UK	rep	Whole of UK	total diet study	1992	24	24	1	2.2	fat	1.37	0.73	nd=LOD	All_PCBs
279	bread, rice, pasta	FR	rep	various regions in France	rural	1998	9	1	9	1.3	whole	0.02		nd=LOD	none
171	cereals food group	UK	rep	Whole of UK	total diet study	1982	24	24	1	7.5	fat	1.76	1.76	nd=LOD	All_PCBs
172	cereals food group	UK	rep	Whole of UK	total diet study	1992	24	24	1	7.1	fat	2.67	0.37	nd=LOD	All_PCBs
343	pastry	SV	rep	National	market basket	1999	8	4	2	24.0	fat	0.72	0.44	nd=LOD	All_PCBs
102	rye	NL	rep	3 largest flour mills	average	1991	3	3	1	1.3	fat	0.77	0.60	nd=LOD	nor_PCBs
58	rye flour	FI	rep	shop	unknown	1998	1	1	1		whole	0.02	0.00	nd=LOD	All_PCBs
103	wheat	NL	rep	3 largest flour mills	average	1991	3	3	1	1.9	fat	0.74	0.19	nd=LOD	nor_PCBs
104	wheat flour	NL	rep	3 largest flour mills	average	1991	3	3	1	1.7	fat	0.85	1.20	nd=LOD	nor_PCBs
59	wheat flour	FI	rep	shop	unknown	1998	1	1	1		whole	0.01	0.00	nd=LOD	All_PCBs
	eggs														
412	eggs	DE	sel			1987	10	10	1		fat	1.52		nd=0.5LOD	none
105	eggs	NL	rep	nation-wide	mixed (DNFCS)	1990	8	4	2	10.0	fat	2.00	1.80	nd=LOD	nor_PCBs
40	eggs	NO	rep	Norway	shops	1990	30	10	3	9.7	whole	0.19	0.86	nd=LOD	All_PCBs
4	eggs	FI	rep	16 largest egg farms		1991	20	5	4		fat	1.55		nd=Zero	none
274	eggs	UK	sel	Derbyshire	farm near industrial site	1991	18	3	6		whole	2.19		nd=LOD	none
414	eggs	DE	rep	Bavaria	chickens in wire cages	1992	230	10	23		fat	0.81		nd=0.5LOD	none
413	eggs	DE	sel	Bavaria	chickens raised on fields	1992	370	10	37		fat	3.20		nd=0.5LOD	none
273	eggs	UK	sel	Derbyshire	farm near industrial site	1992	6	1	6	12.1	whole	0.81		nd=LOD	none
419	eggs	DE	sel	chickens kept on ground		1993	410	10	41		fat	1.51		nd=0.5LOD	none
420	eggs	DE	sel	chickens raised on fields		1993	530	10	53		fat	4.39		nd=0.5LOD	none
415	eggs	DE	rep	chickens in wire cages		1993	200	10	20		fat	1.16		nd=0.5LOD	none
418	eggs	DE	rep	chickens in wire cages		1993	1130	10	113		fat	1.28		nd=0.5LOD	none
417	eggs	DE	sel	chickens raised on fields		1993	230	10	23		fat	1.91		nd=0.5LOD	none
416	eggs	DE	sel	chickens kept on ground		1993	110	10	11		fat	1.81		nd=0.5LOD	none

Annex 3: Occurrence data for dioxins and related PCBs (concentrations in pg/g) in different food products reported by the participating countries

							No. of Samples			Fat		TEQ pg/g		Handling of nd's	PCB selection
ID	Food	Country	rep/sel	Origin	Description	Year	#coll.	/pool	#anal	%	basis	PCDD/F	PCB		
1	eggs	SV	sel	National	mixed	1993	84	12	7	9.3	fat	1.31	1.82	nd=LOD	nor_PCBs
421	eggs	DE	rep	chickens in wire cages		1997	310	10	31		fat	0.99		nd=0.5LOD	none
422	eggs	DE	sel	chickens kept on ground or raised on fields		1997	350	10	35		fat	1.72		nd=0.5LOD	none
423	eggs	DE	rep	chickens in wire cages		1997	290	10	29		fat	0.97		nd=0.5LOD	none
89	eggs	BE	rep	whole Belgium		1998	24	1	24		whole		0.03	nd=LOD	ICES7
426	eggs	DE	sel	Lower Saxony	chickens in wire cages	1998	10	10	1		fat	7.32		nd=0.5LOD	none
425	eggs	DE	sel	Lower Saxony	chickens kept on ground	1998	60	10	6		fat	1.28		nd=0.5LOD	none
424	eggs	DE	sel	Lower Saxony	chickens raised on fields	1998	80	10	8		fat	0.75		nd=0.5LOD	none
427	eggs	DE	rep	Lower Saxony	chickens in wire cages	1998	60	10	6		fat	1.53		nd=0.5LOD	none
282	eggs	FR	rep	various in France	rural	1998	5	1	5	17.5	fat	0.46		nd=LOD	none
292	eggs	NL	rep	nation wide	average	1999	100	50	2	12.1	fat	1.08	0.44	nd=LOD	nor_PCBs
323	eggs	SV	rep	National	market basket	1999	32	8	4	10.6	fat	1.03	1.45	nd=LOD	All_PCBs
162	eggs food group	UK	rep	Whole of UK	total diet study	1982	24	24	1	11.1	fat	8.25	2.36	nd=LOD	All_PCBs
178	eggs food group	UK	sel	Scotland and Wales	total diet study	1988	2	1	2		whole	0.19		nd=LOD	none
163	eggs food group	UK	rep	Whole of UK	total diet study	1992	24	24	1	9.6	fat	1.77	0.97	nd=LOD	All_PCBs
254	pastorized	IT	rep	Imported	chicken farms	1999	1	1	1	9.0	fat	3.30		nd=0.5LOD	none
255	yolk dried	IT	rep	Imported	chicken farms	1999	1	1	1	56.5	fat	1.00		nd=0.5LOD	none
253	yolk dried	IT	rep	Imported	chicken farms	1999	1	1	1	55.0	fat	3.70		nd=0.5LOD	none
	fats and oils														
324	cooking fats and oils	SV	rep	National	market basket	1999	8	4	2	69.8	fat	0.77	0.42	nd=LOD	All_PCBs
166	fats and oils	UK	rep	Whole of UK	total diet study	1982	24	24	1	100.0	fat	1.26	1.29	nd=LOD	All_PCBs
168	fats and oils	UK	sel	Scotland and Wales	total diet study	1988	2	1	2		whole	0.65		nd=LOD	none
167	fats and oils	UK	rep	Whole of UK	total diet study	1992	24	24	1	78.3	fat	0.26	0.35	nd=LOD	All_PCBs
114	fish oil	NL	rep	various countries	raw (food industry)	1990	10	1	10	100.0	fat	3.36	4.06	nd=LOD	nor_PCBs
115	fish oil	NL	rep	various countries	refined (food industry)	1990	7	1	7	100.0	fat	0.99	1.27	nd=LOD	nor_PCBs

Annex 3: Occurrence data for dioxins and related PCBs (concentrations in pg/g) in different food products reported by the participating countries

ID	Food	Country	rep/sel	Origin	Description	Year	No. of Samples #coll.	/pool	#anal	Fat %	Fat basis	TEQ pg/g PCDD/F	PCB	Handling of nd's	PCB selection
39	margarine (based on marine oils)	NO	sel	whole of Norway	retail	1989	40	10	4	81.0	whole	1.62		nd=LOD	none
130	vegetable oils	NL	rep	various countries	food industry	1990	8	1	8	100.0	fat	0.17	0.03	nd=LOD	nor_PCBs
	fish / fish products														
467	alaska pollock	DE	rep	Alaska		1997	60	15	4		whole	0.01		nd=Zero	none
311	anchovy	IT	rep	Northern Adriatic sea	retail	1997	8	8	1	3.3	whole	0.47		nd=0.5LOD	none
319	anchovy	IT	rep	Southern Adriatic sea	retail	1997	6	6	1	1.8	whole	0.23		nd=0.5LOD	none
218	anchovy	IT	rep	Central Adriatic sea	retail	1997	7	7	1	3.1	whole	0.34		nd=0.5LOD	none
12	burbot, liver	SV	rep	Bothnian Bay		1989	15	5	3	45.6	whole	87.89	13.70	nd=LOD	nor_PCBs
13	burbot, muscle	SV	rep	Bothnian Bay		1989	15	5	3	0.7	whole	0.87	0.33	nd=LOD	nor_PCBs
468	carp	DE	rep	Bavaria		1996	11	1	11		whole	1.30		nd=0.5LOD	none
469	carp, farmed	DE	rep	Bavaria		1996	4	1	4		whole	0.73		nd=0.5LOD	none
470	carp, farmed	DE	rep	Bavaria		1997	11	1	11		whole	0.19		nd=0.5LOD	none
471	catfish	DE	rep			1997	45	15	3		whole	0.52		nd=Zero	none
212	clam	IT	rep	Central Adriatic sea	fishing harbors/ retail	1997	7	7	1	1.1	whole	0.10		nd=0.5LOD	none
305	clam	IT	rep	Northern Adriatic sea	fishing harbors/retail	1997	10	10	1	1.0	whole	0.14		nd=0.5LOD	none
313	clam	IT	rep	Southern Adriatic sea	fishing harbors/ retail	1997	3	3	1	0.9	whole	0.07		nd=0.5LOD	none
472	coalfish	DE	rep	Norway, North Sea		1997	105	15	7		whole	0.07		nd=Zero	none
473	cod	DE	rep	retail		1987	1	1	1		fat	42.70		nd=0.5LOD	none
261	cod	UK	rep	UK landed	fish market	1995	30	1	30	0.5	fat	6.83	14.00	nd=LOD	All_PCBs
474	cod	DE	rep	Norway, North Sea		1997	195	15	13		whole	0.05		nd=Zero	none
35	cod liver	NO	rep	Nothern Norway	open sea	1994	75	25	3	59.8	whole	4.80	56.87	nd=LOD	All_PCBs
232	cod liver baltic	DK	rep	Baltic, Bornholm		1987	6	1	6	69.9	fat	40.93		nd=Zero	none
198	cod liver oil	UK	rep	England	retail (bottled)	1994	4	1	4	100.0	fat	6.52	15.40	nd=LOD	All_PCBs
200	cod liver oil	UK	rep	England	retail (bottled)	1996	5	1	5	100.0	fat	4.36	16.61	nd=LOD	All_PCBs
32	cod liver oil (processed)	NO	rep	Norway	production site	1994	15	5	3	100.0	whole	0.53	2.56	nd=LOD	All_PCBs
33	cod muscle	NO	rep	Norway	open sea	1989	50	25	2	0.3	whole	0.12		nd=LOD	none

Annex 3: Occurrence data for dioxins and related PCBs (concentrations in pg/g) in different food products reported by the participating countries

ID	Food	Country	rep/sel	Origin	Description	Year	No. of Samples #coll.	/pool	#anal	Fat %	Fat basis	TEQ pg/g PCDD/F	TEQ pg/g PCB	Handling of nd's	PCB selection
327	cod muscle	SV	rep	National	market basket	1999	8	8	1	0.3	whole	0.13	0.23	nd=LOD	All_PCBs
34	cod roe	NO	rep	Nothern Norway	open sea	1994	25	25	1	2.8	whole	0.20	3.49	nd=LOD	nor_PCBs
511	crab hepatopancreas Norway	NO	rep	Southern and Western coast of	background areas	1996	165	15	11	14.8	whole	10.24	7.64	nd=LOD	nor_PCBs
17	eel	SV	sel	Baltic Sea		1992	5	1	5	19.9	whole		13.41	nd=LOD	nor_PCBs
203	eel	UK	rep	Whole of UK	commercial fisheries	1996	10	1	10	21.1	whole	1.55	8.39	nd=LOD	All_PCBs
475	eel	DE	rep	Bavaria		1996	10	1	10		whole	1.30		nd=0.5LOD	none
476	eel	DE	rep	Lower Saxony		1997	5	1	5		whole	1.98		nd=0.5LOD	none
118	fatty sea fish	NL	rep	nation-wide	mixed (DNFCS)	1990	8	4	2	16.1	fat	6.77	10.51	nd=LOD	nor_PCBs
489	fish	DE	rep	representative, market share		1988	52	1	52		whole	0.70		nd=0.5LOD	none
87	fish	BE	rep	whole Belgium	1995 - 1998	1995	164	1	164		whole		0.53	nd=LOD	ICES7
492	fish	DE	rep	representative, market share		1997	2760	15	184		whole	0.29		nd=Zero	none
164	fish food groop	UK	rep	Whole of UK	total diet study	1982	24	24	1	7.8	fat	5.30	11.53	nd=LOD	All_PCBs
169	fish food group	UK	sel	Scotland and Wales	total diet study	1988	2	1	2		whole	0.39		nd=LOD	none
165	fish food group	UK	rep	Whole of UK	total diet study	1992	24	24	1	7.8	fat	2.71	5.32	nd=LOD	All_PCBs
201	fish oils	UK	rep	England	retail (capsules)	1996	10	1	10	100.0	fat	2.73	11.77	nd=LOD	All_PCBs
269	fishfingers	UK	sel	England (one region)	retail	1995	12	1	12	8.0	fat	0.63	1.61	nd=LOD	All_PCBs
117	freshwater fish	NL	rep	nation-wide	mixed (DNFCS)	1990	8	4	2	7.6	fat	2.39	4.50	nd=LOD	nor_PCBs
262	haddock	UK	rep	UK landed	fish market	1995	26	1	26	0.5	fat	5.21	6.71	nd=LOD	All_PCBs
477	haddock	DE	rep	Norway		1997	30	15	2		whole	0.04		nd=Zero	none
478	hake	DE	rep	Biskaya, Chile, Argentinia		1997	60	15	4		whole	0.03		nd=Zero	none
199	halibut liver oil	UK	rep	England	retail (capsules)	1994	4	1	4	100.0	fat	4.58	4.88	nd=LOD	All_PCBs
479	halibut, black	DE	rep	Atlantic, North Sea		1997	375	15	25		whole	0.74		nd=Zero	none
480	halibut, white	DE	rep	Greenland		1997	15	15	1		whole	0.18		nd=Zero	none
231	herring	DK	rep	Baltic, Bornholm		1987	7	1	7	15.6	fat	58.28		nd=Zero	none
481	herring	DE	sel			1987	1	1	1		fat	33.70		nd=0.5LOD	none

Annex 3: Occurrence data for dioxins and related PCBs (concentrations in pg/g) in different food products reported by the participating countries

							No. of Samples			Fat		TEQ pg/g		Handling of nd's	PCB selection
ID	Food	Country	rep/sel	Origin	Description	Year	#coll.	/pool	#anal	%	basis	PCDD/F	PCB		
482	herring median	DE	rep	Atlantic, North Sea, Baltic,		1988	38	1	38		whole	1.40		nd=Zero	none
6	herring	FI	rep	Baltic Sea		1991	1200	12	100	3.8	whole	8.00	7.85	nd=Zero	nor_PCBs
37	herring	NO	rep	Norway	open sea	1993	100	25	4	24.4	whole	0.91	2.64	nd=LOD	All_PCBs
266	herring	UK	rep	UK landed	fish market	1995	10	1	10	9.6	fat	20.86	59.84	nd=LOD	All_PCBs
483	herring	DE	rep	Atlantic, North Sea, Baltic, retail		1997	825	15	55		whole	0.79		nd=Zero	none
329	herring muscle	SV	rep	Bothnian Bay	mixed	1998	20	20	1	4.6	whole	2.34	1.33	nd=LOD	All_PCBs
330	herring muscle	SV	rep	Swedish West coast	mixed	1998	14	14	1	12.3	whole	0.73	1.11	nd=LOD	All_PCBs
328	herring muscle	SV	rep	National	market basket	1999	6	6	1	6.0	whole	4.03	1.32	nd=LOD	nor_PCBs
2	herring, muscle	SV	rep	Baltic Sea		1988	120	20	6	8.4	whole	8.27	9.02	nd=LOD	nor_PCBs
3	herring, muscle	SV	rep	Swedish West Coast		1989	30	15	2	17.2	whole	1.85	2.80	nd=LOD	nor_PCBs
11	herring, muscle	SV	rep	Bothnian Bay - Baltic Sea		1990	170	17	10	7.7	whole	10.56	10.07	nd=LOD	nor_PCBs
116	lean sea fish	NL	rep	nation-wide	mixed (DNFCS)	1990	8	4	2	0.9	fat	48.63	102.95	nd=LOD	nor_PCBs
38	mackerel	NO	rep	Nothern Norway	open sea	1992	75	25	3	20.2	whole	0.52	1.40	nd=LOD	All_PCBs
267	mackerel	UK	rep	UK landed	fish market	1995	13	1	13	16.6	fat	3.48	13.89	nd=LOD	All_PCBs
307	mackerel	IT	rep	Northern Adriatic sea	retail	1997	6	6	1	8.7	whole	0.59		nd=0.5LOD	none
214	mackerel	IT	rep	Central Adriatic sea	retail	1997	7	7	1	7.3	whole	0.94		nd=0.5LOD	none
315	mackerel	IT	rep	Southern Adriatic sea	retail	1997	6	6	1	5.6	whole	1.07		nd=0.5LOD	none
484	mackerel	DE	rep	Biskaya		1997	255	15	17		whole	0.29		nd=Zero	none
326	mixed fish	SV	rep	National	market basket	1999	8	4	2	6.1	whole	0.39	0.55	nd=LOD	All_PCBs
286	molluscs and crustaceans	FR	rep	all France	rural	1998	13	1	13	4.4	fat	31.99		nd=LOD	none
136	mussel	UK	sel	Northern Ireland	marine	1996	28	28	1		whole			nd=Zero	ICES7
309	mussel	IT	rep	Northern Adriatic sea	fishing harbors/ retail	1997	6	6	1	1.6	whole	0.24		nd=0.5LOD	none
216	mussel	IT	rep	Central Adriatic sea	fishing harbors/ retail	1997	2	2	1	1.4	whole	0.16		nd=0.5LOD	none
317	mussel	IT	rep	Southern Adriatic sea	fishing harbors/retail	1997	4	4	1	1.4	whole	0.11		nd=0.5LOD	none
133	mussel	UK	sel	Northern Ireland	marine	1998	46	46	1		whole			nd=Zero	ICES7

Annex 3: Occurrence data for dioxins and related PCBs (concentrations in pg/g) in different food products reported by the participating countries

							No. of Samples			Fat		TEQ pg/g		Handling of nd's	PCB selection
ID	Food	Country	rep/sel	Origin	Description	Year	#coll.	/pool	#anal	%	basis	PCDD/F	PCB		
316	norway lobster	IT	rep	Southern Adriatic sea	retail	1997	6	6	1	0.7	whole	0.12		nd=0.5LOD	none
308	norway lobster	IT	rep	Northern Adriatic sea	retail	1997	5	5	1	0.6	whole	0.14		nd=0.5LOD	none
215	norway lobster	IT	rep	Central Adriatic sea	retail	1997	7	7	1	0.5	whole	0.09		nd=0.5LOD	none
135	oyster	UK	sel	Northern Ireland	marine	1996	6	6	1		whole			nd=Zero	ICES7
134	oyster	UK	sel	Northern Ireland	marine	1997	11	11	1		whole			nd=Zero	ICES7
132	oyster	UK	sel	Northern Ireland	marine	1998	11	11	1		whole			nd=Zero	ICES7
332	pike muscle	SV	rep	National	market basket	1999	8	8	1	0.4	whole	0.90	0.67	nd=LOD	All_PCBs
36	plaice	NO	rep	Nothern Norway	open sea	1994	25	25	1	0.6	whole	0.19	2.62	nd=LOD	All_PCBs
263	plaice	UK	rep	UK landed	fish market	1995	13	1	13	1.3	fat	21.20	40.30	nd=LOD	All_PCBs
485	plaice	DE	rep	North Sea		1997	45	15	3		whole	0.28		nd=Zero	none
15	plaice, muscle	SV	sel	Swedish West Coast		1989	45	15	3	0.8	whole	0.36	0.39	nd=LOD	nor_PCBs
325	rainbow trout (farmed)	SV	rep	National	mixed	1998	5	5	1	2.9	whole	0.81	1.14	nd=LOD	All_PCBs
265	red fish	UK	sel	UK landed	fish market	1995	2	1	2	3.5	fat	12.96	43.57	nd=LOD	All_PCBs
314	red mullet	IT	rep	Southern Adriatic sea	retail	1997	6	6	1	4.3	whole	0.38		nd=0.5LOD	none
213	red mullet	IT	rep	Central Adriatic sea	retail	1997	7	7	1	4.4	whole	0.37		nd=0.5LOD	none
306	red mullet	IT	rep	Northern Adriatic sea	retail	1997	5	5	1	4.9	whole	0.56		nd=0.5LOD	none
486	redfish	DE	rep	retail		1987	1	1	1	fat	30.70			nd=0.5LOD	none
487	redfish	DE	rep	Atlantic, North Sea		1997	225	15	15		whole	0.23		nd=Zero	none
20	salmon	SV	sel	Baltic Sea	mixed	1992	10	1	10	22.5	whole		19.19	nd=LOD	nor_PCBs
31	salmon	NO	rep	Nothern Norway	fish farms	1994	75	25	3	16.7	whole	0.95	3.99	nd=LOD	All_PCBs
268	salmon	UK	rep	UK landed	fish market	1995	12	1	12	13.6	fat	5.54	18.45	nd=LOD	All_PCBs
22	salmon	SV	rep	Baltic Sea	mixed	1996	57	19	3	6.2	whole	7.04	9.12	nd=LOD	All_PCBs
331	salmon (farmed)	SV	rep	Norway	market basket	1999	8	8	1	11.7	whole	1.04	1.16	nd=LOD	All_PCBs
488	salmon, farmed	DE	rep	Norway, retail		1997	135	15	9		whole	0.43		nd=Zero	none
490	salt water fish	DE	rep	retail		1993	42	1	42		whole	0.17		nd=0.5LOD	none
491	salt water fish	DE	rep			1997	26	1	26		whole	0.48		nd=0.5LOD	none
493	sardine	DE	rep	Biskaya, retail		1997	100	20	5		whole	0.43		nd=Zero	none

Annex 3: Occurrence data for dioxins and related PCBs (concentrations in pg/g) in different food products reported by the participating countries

ID	Food	Country	rep/sel	Origin	Description	Year	No. of Samples #coll.	/pool	#anal	Fat %	basis	TEQ pg/g PCDD/F	PCB	Handling of nd's	PCB selection
285	sea fish	FR	rep	all France	rural	1998	56	1	56	8.8	fat	7.17		nd=LOD	none
217	squid	IT	rep	Central Adriatic sea	retail	1997	7	7	1	1.8	whole	0.17		nd=0.5LOD	none
318	squid	IT	rep	Southern Adriatic sea	retail	1997	6	6	1	1.2	whole	0.12		nd=0.5LOD	none
310	squid	IT	rep	Northern Adriatic sea	retail	1997	8	8	1	1.9	whole	0.25		nd=0.5LOD	none
494	trout	DE	rep	mainly Black Forest		1993	61	1	61		whole	0.33		nd=0.5LOD	none
202	trout	UK	rep	England and Wales	fish farm	1995	40	1	40	4.8	fat	5.08	18.75	nd=LOD	All_PCBs
495	trout	DE	rep	Bavaria		1996	19	1	19		whole	0.46		nd=0.5LOD	none
498	trout	DE	rep	Lower Saxony		1997	9	1	9		whole	0.61		nd=0.5LOD	none
496	trout	DE	rep			1997	10	1	10		whole	0.38		nd=0.5LOD	none
500	trout	DE	rep	retail		1997	5	1	5		whole	0.27		nd=Zero	none
5	trout (rainbow)	FI	rep	unknown hatching station		1993	5	5	1	9.2	whole	1.79	0.53	nd=Zero	nor_PCBs
260	trout (rainbow)	FI	rep	Southern Finland		1999	40	5	8	8.3	whole	0.74	1.49	nd=LOD	All_PCBs
497	trout, farmed	DE	rep	Bavaria		1996	32	1	32		whole	0.44		nd=0.5LOD	none
499	trout, farmed	DE	rep	Lower Saxony		1997	3	1	3		whole	0.07		nd=0.5LOD	none
501	tuna/bonite	DE	rep	retail		1997	70	7	10		whole	0.01		nd=Zero	none
14	whitefish, muscle	SV	rep	Bothnian Bay		1989	42	14	3	4.4	whole	7.40	4.66	nd=LOD	nor_PCBs
16	whitefish, muscle	SV	sel	Baltic Sea		1992	6	2	3	2.5	whole		3.44	nd=LOD	nor_PCBs
264	whiting	UK	rep	UK landed	fish market	1995	14	1	14	0.5	fat	7.23	23.70	nd=LOD	All_PCBs
	fruit and vegetables														
75	cabbage	FI	rep	Central Finland		1998	1	1	1		whole	0.01	0.00	nd=LOD	All_PCBs
74	carrot	FI	rep	Central Finland		1998	1	1	1		whole	0.01	0.00	nd=LOD	All_PCBs
69	cucumber	FI	rep	Central Finland		1998	1	1	1		whole	0.01	0.00	nd=LOD	All_PCBs
131	curly kale	NL	sel	various regions in NL	industrial and rural	1991	14	1	14		whole	0.88		nd=LOD	none
161	fresh fruit food group	UK	sel	Scotland and Wales	total diet study	1988	2	1	2		whole	0.05		nd=LOD	none
502	fruit and vegetables	DE	rep			1993	57	1	57		whole	0.01		nd=0.5LOD	none
503	fruit and vegetables	DE	rep			1997	30	1	30		whole	0.01		nd=0.5LOD	none
281	fruits orange,apple,raisin	FR	rep	various regions in France	rural	1999	5	1	5	0.3	whole	0.03		nd=LOD	none

Annex 3: Occurrence data for dioxins and related PCBs (concentrations in pg/g) in different food products reported by the participating countries

ID	Food	Country	rep/sel	Origin	Description	Year	No. of Samples #coll.	/pool	#anal	Fat %	basis	TEQ pg/g PCDD/F	PCB	Handling of nd's	PCB selection
158	green vegetable food group	UK	sel	Scotland and Wales	total diet study	1988	2	1	2		whole	0.02		nd=LOD	none
504	kale	DE	sel	Lower Saxony		1998	9	1	9		whole	0.06		nd=0.5LOD	none
68	lettuce	FI	rep	Southern Finland	head lettuce	1998	1	1	1		whole	0.05	0.12	nd=LOD	All_PCBs
67	lettuce	FI	rep	Southern Finland	ice lettuce	1998	1	1	1		whole	0.01	0.03	nd=LOD	All_PCBs
66	lettuce	FI	rep	Central Finland	pot lettuce	1998	1	1	1		whole	0.02	0.00	nd=LOD	All_PCBs
73	onion	FI	rep	Central Finland		1998	1	1	1		whole	0.01	0.00	nd=LOD	All_PCBs
65	orange juice	FI	rep	import	unknown	1998	1	1	1		whole	0.00	0.00	nd=LOD	All_PCBs
159	other vegetables food group	UK	sel	Scotland and Wales	total diet study	1988	2	1	2		whole	0.09		nd=LOD	none
76	paprika	FI	rep	Central Finland		1998	1	1	1		whole	0.01	0.00	nd=LOD	All_PCBs
71	potato	FI	rep	Central Finland	old potato	1998	1	1	1		whole	0.01	0.00	nd=LOD	All_PCBs
70	potato	FI	rep	Central Finland	new potato	1998	1	1	1		whole	0.01	0.00	nd=LOD	All_PCBs
160	potato food group	UK	sel	Scotland and Wales	total diet study	1988	2	1	2		whole	0.04		nd=LOD	none
64	strawberry	FI	rep	Central Finland	rural	1998	1	1	1		whole	0.01	0.00	nd=LOD	All_PCBs
72	tomato	FI	rep	Central Finland		1998	1	1	1		whole	0.01	0.00	nd=LOD	All_PCBs
280	vegetables	FR	rep	various regions in France	rural	1998	34	1	34	0.7	whole	0.09		nd=LOD	none
	human milk														
344	human milk	DE	rep	whole country	1986 - 1990	1986	728	1	728		fat	30.72		nd=0.5LOD	none
508	human milk	DK	rep	Whole of Denmark		1986	8	1	8	4.2	fat	18.10		nd=LOD	none
205	human milk	FI	rep	Finland	primi- and multiparae	1987	167	1	167	3.4	fat	20.00	25.30	nd=LOD	All_PCBs
301	human milk	IT	rep	Milan	town	1987	14	14	1	2.3	fat	18.00		nd=0.5LOD	nor_PCBs
302	human milk	IT	rep	Florence	town + rural	1987	27	27	1	3.3	fat	29.00		nd=0.5LOD	nor_PCBs
303	human milk	IT	rep	Rome	town	1987	9	9	1	3.5	fat	22.00		nd=0.5LOD	nor_PCBs
304	human milk	IT	rep	Pavia	rural villages	1987	9	9	1	3.7	fat	31.00	16.00	nd=0.5LOD	nor_PCBs
138	human milk	UK	sel	England and Scotland	primiparae	1987	80	40	2	3.1	fat	33.00		nd=LOD	none
119	human milk	NL	rep	whole country	primi- and multiparae	1988	120	12	10	3.0	fat	34.20		d=Zero	none

Annex 3: Occurrence data for dioxins and related PCBs (concentrations in pg/g) in different food products reported by the participating countries

ID	Food	Country	rep/sel	Origin	Description	Year	No. of Samples #coll.	/pool	#anal	Fat %	basis	TEQ pg/g PCDD/F	PCB	Handling of nd's	PCB selection
120	human milk	NL	rep	whole country	primi- and multiparae	1988	96	1	96	2.9	fat			nd=Zero	ICES7
206	human milk	SV	rep	Stockholm	multiparae	1990	160	20	8	2.5	fat	16.48	22.13	nd=LOD	All_PCBs
121	human milk	NL	sel	Rotterdam and Groningen	urban	1990	176	1	176		fat	30.16	35.52	nd=Zero	nor_PCBs
509	human milk	NO	rep	Oslo		1991	28	1	28	100.0	fat		32.51	nd=0.5LOD	All_PCBs
347	human milk	DE	rep	North-Rhine-Westphalia		1991	111	1	111		fat	23.40		nd=0.5LOD	none
346	human milk	DE	rep	Schleswig-Holstein		1991	3	1	3		fat	32.88		nd=0.5LOD	none
345	human milk	DE	rep	Lower Saxony		1991	77	1	77		fat	24.75		nd=0.5LOD	none
350	human milk	DE	rep	Bavaria		1992	2	1	2		fat	16.65		nd=0.5LOD	none
351	human milk	DE	rep	Schleswig-Holstein		1992	4	1	4		fat	22.93		nd=0.5LOD	none
349	human milk	DE	rep	North-Rhine-Westphalia		1992	56	1	56		fat	20.55		nd=0.5LOD	none
348	human milk	DE	rep	Lower Saxony		1992	109	1	109		fat	20.60		nd=0.5LOD	none
78	human milk	DK	rep	Whole of Denmark		1993	37	1	37	3.2	fat		18.90	nd=LOD	All_PCBs
77	human milk	DK	rep	Whole of Denmark		1993	10	1	10	3.5	fat	16.72	17.20	nd=LOD	All_PCBs
63	human milk	FI	rep	Finland	primi- and multiparae	1993	84	1	84	4.0	fat	13.20	12.00	nd=LOD	All_PCBs
139	human milk	UK	sel	England and Scotland	primiparae	1993				3.3	fat	20.88	11.09	nd=LOD	All_PCBs
510	human milk	NO	rep	Norway		1993	30	10	3	2.7	whole	0.28	0.70	nd=LOD	All_PCBs
353	human milk	DE	rep	North-Rhine-Westphalia		1993	78	1	78		fat	20.90		nd=0.5LOD	none
356	human milk	DE	rep	Berlin	urban	1993	10	10	1		fat	16.58		nd=0.5LOD	none
354	human milk	DE	rep	Baden-Württemberg		1993	5	1	5		fat	18.42		nd=0.5LOD	none
352	human milk	DE	rep	Lower Saxony		1993	45	1	45		fat	16.01		nd=0.5LOD	none
355	human milk	DE	rep	Schleswig-Holstein		1993	3	1	3		fat	18.46		nd=0.5LOD	none
122	human milk	NL	rep	whole country	primiparae only	1993	103	1	103	2.7	fat	23.52	20.96	nd=Zero	All_PCBs
79	human milk	BE	rep	Brabant Wallon	residential (representative in combination with 80 and 81)	1993	8	8	1	3.8	fat	20.80	7.40	nd=Zero	All_PCBs
81	human milk	BE	rep	Liege	residential (representative in combination with 79 and 80)	1993	20	20	1	3.0	fat	27.10	4.70	nd=Zero	All_PCBs
80	human milk	BE	rep	Brussels	residential (representative in combination with 79 and 81)	1993	6	6	1	2.8	fat	26.60	7.80	nd=Zero	All_PCBs

Annex 3: Occurrence data for dioxins and related PCBs (concentrations in pg/g) in different food products reported by the participating countries

ID	Food	Country	rep/sel	Origin	Description	Year	No. of Samples #coll.	/pool	#anal	Fat %	basis	TEQ pg/g PCDD/F	PCB	Handling of nd's	PCB selection
357	human milk	DE	rep	Baden-Württemberg		1994	6	1	6		fat	23.89		nd=0.5LOD	none
359	human milk	DE	rep	North-Rhine-Westphalia		1994	50	1	50		fat	17.20		nd=0.5LOD	none
358	human milk	DE	rep	Lower Saxony		1994	34	1	34		fat	16.78		nd=0.5LOD	none
18	human milk	SV	rep	Uppsala/Sundsvall	primiparae	1994	10	1	10	2.5	fat	10.18	16.71	nd=LOD	All_PCBs
362	human milk	DE	rep	North-Rhine-Westphalia		1995	38	1	38		fat	16.10		nd=0.5LOD	none
361	human milk	DE	rep	Lower Saxony		1995	83	1	83		fat	18.74		nd=0.5LOD	none
360	human milk	DE	rep	Baden-Württemberg		1995	14	1	14		fat	17.53		nd=0.5LOD	none
364	human milk	DE	rep	Lower Saxony		1996	18	1	18		fat	16.64		nd=0.5LOD	none
363	human milk	DE	rep	Baden-Württemberg		1996	41	5	9		fat	12.76		nd=0.5LOD	none
365	human milk	DE	rep	North-Rhine-Westphalia		1996	22	1	22		fat	14.07		nd=0.5LOD	none
19	human milk	SV	rep	Uppsala	primiparae	1997	63	1	63	3.3	fat	7.90	9.90	nd=LOD	nor_PCBs
366	human milk	DE	rep	Baden-Württemberg		1997	82	7	11		fat	11.02		nd=0.5LOD	none
371	human milk	DE	rep	Bavaria		1997	1	1	1		fat	14.99		nd=0.5LOD	none
369	human milk	DE	rep	Bavaria	primimarae	1997	9	9	1	4.6	fat	14.16		nd=0.5LOD	none
368	human milk	DE	rep	North-Rhine-Westphalia		1997	11	1	11		fat	11.90		nd=0.5LOD	none
367	human milk	DE	rep	Lower Saxony		1997	15	1	15		fat	12.74		nd=0.5LOD	none
370	human milk	DE	rep	Bavaria	multiparae	1997	8	8	1	3.4	fat	10.98		nd=0.5LOD	none
373	human milk	DE	rep	Lower Saxony		1998	25	1	25		fat	12.32		nd=0.5LOD	none
375	human milk	DE	rep	Bavaria	primiparae	1998	6	6	1	3.9	fat	10.50		nd=0.5LOD	none
374	human milk	DE	rep	North-Rhine-Westphalia		1998	15	1	15		fat	13.83		nd=0.5LOD	none
372	human milk	DE	rep	Baden-Württemberg		1998	23	4	6		fat	13.52		nd=0.5LOD	none
505	human milk	FR	rep	France		1998	244	1	244	3.0	fat	16.47		nd=LOD	none
	meat / meat products														
137	UK	selNorthern Ireland			rural	1993	650	650	1		fat			nd=Zero	ICES7
86	BE	repwhole Belgium			1995 - 1998	1995	732	1	732		fat		0.60	nd=LOD	ICES7
428	beef	DE	sel			1987	1	1	1		fat	2.59		nd=0.5LOD	none
429	beef	DE	sel			1989	3	1	3		fat	3.50		nd=0.5LOD	none

Annex 3: Occurrence data for dioxins and related PCBs (concentrations in pg/g) in different food products reported by the participating countries

							No. of Samples			Fat		TEQ pg/g		Handling of nd's	PCB selection
ID	Food	Country	rep/sel	Origin	Description	Year	#coll.	/pool	#anal	%	basis	PCDD/F	PCB		
23	beef	SV	sel	national	rural (cow fat)	1989	2	1	2	83.2	fat	1.29	1.16	nd=LOD	nor_PCBs
60	beef	FI	rep	from four biggest slaughterhouses	bovine beef	1991	20	5	4		fat	0.02		nd=Zero	none
430	beef	DE	rep			1993	14	1	14		fat	0.71		nd=0.5LOD	none
431	beef	DE	rep	Bavaria		1995	15	1	15		fat	0.50		nd=0.5LOD	none
432	beef	DE	rep	nation-wide		1996	32	1	32		fat	0.46		nd=Zero	none
433	beef	DE	rep			1997	21	1	21		fat	0.76		nd=0.5LOD	none
434	beef	DE	rep	Bavaria		1997	9	1	9		fat	0.72		nd=0.5LOD	none
336	beef	SV	rep	National	mixed (cow fat)	1998	20	10	2	85.0	fat	0.98	1.08	nd=LOD	All_PCBs
289	beef	NL	rep	nation wide	mixed (DNFCS)	1999	10	5	2	13.1	fat	0.72	0.97	nd=LOD	nor_PCBs
96	beef, fat	NL	rep	nation-wide	average	1990	80	40	2	100.0	fat	1.77	2.40	nd=LOD	nor_PCBs
234	beef, ground meat	DK	rep	Copenhagen		1987	4	1	4	19.7	fat	2.39		nd=Zero	none
233	beef, kidney fat	DK	rep	Copenhagen		1987	3	1	3	85.2	fat	2.82		nd=Zero	none
141	carcase meat food group	UK	rep	Whole of UK	total diet study	1982	24	24	1	17.4	fat	2.79	1.93	nd=LOD	All_PCBs
154	carcase meat food group	UK	sel	Scotland and Wales		1988	2	1	2		whole	0.70		nd=LOD	none
142	carcase meat food group	UK	rep	Whole of UK	total diet study	1992	24	24	1	13.7	fat	0.94	0.87	nd=LOD	All_PCBs
45	cattle fat	NO	rep	Norway	rural	1991	30	10	3	100.0	fat	0.33	1.35	nd=LOD	All_PCBs
448	chicken	DE	sel			1987	1	1	1		fat	2.25		nd=0.5LOD	none
449	chicken	DE	sel			1989	2	1	2		fat	2.30		nd=0.5LOD	none
455	chicken	DE	rep	Bavaria		1998	15	1	15		fat	0.38		nd=0.5LOD	none
242	chicken	IT	rep	Imported	chicken farm	1999	1	1	1	10.2	fat	0.93		nd=0.5LOD	none
241	chicken	IT	rep	Imported	chicken farm	1999	1	1	1	7.6	fat	1.40		nd=0.5LOD	none
240	chicken	IT	rep	Imported	chicken farm	1999	1	1	1	11.0	fat	0.44		nd=0.5LOD	none
290	chicken	NL	rep	nation wide	mixed (DNFCS)	1999	10	5	2	6.2	fat	0.89	0.59	nd=LOD	nor_PCBs
97	chicken, fat	NL	rep	nation-wide	average	1990	80	40	2	100.0	fat	1.63	1.60	nd=LOD	nor_PCBs
91	chicken, liver	NL	rep	nation-wide	average	1990	80	40	2	5.5	fat	3.30	2.10	nd=LOD	nor_PCBs
90	cow, liver	NL	rep	nation-wide	average	1990	80	40	2	6.1	fat	5.70	3.70	nd=LOD	nor_PCBs

Annex 3: Occurrence data for dioxins and related PCBs (concentrations in pg/g) in different food products reported by the participating countries

							No. of Samples			Fat		TEQ pg/g		Handling of nd's	PCB selection
ID	Food	Country	rep/sel	Origin	Description	Year	#coll.	/pool	#anal	%	basis	PCDD/F	PCB		
333	deer	SV	rep	National	mixed	1998	4	4	1	82.3	fat	0.97	3.15	nd=LOD	All_PCBs
456	duck	DE	rep	Bavaria		1998	12	1	12		fat	0.50		nd=0.5LOD	none
124	game	NL	rep	nation-wide	mixed (DNFCS)	1990	16	4	4	7.1	fat	17.00	17.00	nd=LOD	nor_PCBs
464	game	DE	rep	Bavaria		1997	8	1	8		fat	1.97		nd=0.5LOD	none
463	game	DE	rep			1997	27	1	27		fat	1.94		nd=0.5LOD	none
100	goat, fat	NL	rep	nation-wide	average	1990	80	40	2	100.0	fat	4.20	7.70	nd=LOD	nor_PCBs
94	goat, liver	NL	rep	nation-wide	average	1990	80	40	2	9.3	fat	42.00	28.00	nd=LOD	nor_PCBs
438	ham	DE	rep			1993	8	1	8		fat	0.39		nd=0.5LOD	none
441	ham	DE	rep	nation-wide		1996	12	1	12		fat	0.18	n	d=Zero	none
98	horse, fat	NL	rep	nation-wide	average	1990	80	40	2	100.0	fat	14.00	25.00	nd=LOD	nor_PCBs
92	horse, liver	NL	rep	nation-wide	average	1990	80	40	2	6.7	fat	61.00	20.00	nd=LOD	nor_PCBs
46	lamb fat	NO	rep	Norway	rural	1994	30	10	3	100.0	fat	0.31	0.33	nd=LOD	nor_PCBs
457	lamb, sheep	DE	rep			1987	1	1	1		fat	1.65		nd=0.5LOD	none
458	lamb, sheep	DE	rep			1989	2	1	2		fat	2.00		nd=0.5LOD	none
459	lamb, sheep	DE	rep			1993	13	1	13		fat	0.52		nd=0.5LOD	none
465	liver (beef, veal)	DE	rep	Bavaria		1995	22	1	22		fat	2.60		nd=0.5LOD	none
466	liver (pork)	DE	rep	Bavaria		1995	8	1	8		fat	3.00		nd=0.5LOD	none
339	liver cow	SV	rep	Uppsala	mixed	1999	8	8	1	4.5	fat	0.95	1.65	nd=LOD	All_PCBs
338	liver pate	SV	rep	National	mixed	1999	8	8	1	29.9	fat	2.13	0.27	nd=LOD	All_PCBs
283	meat and poultry	FR	rep	various in France +6 samples imported	rural poultry, beef, sheep,pig	1998	50	1	50	14.7	fat	0.63		nd=LOD	none
123	meat products	NL	rep	nation-wide	mixed (DNFCS)	1990	8	4	2	28.0	fat	0.68	0.48	nd=LOD	nor_PCBs
145	meat products food	UK	rep	Whole of UK	total diet study	1982	24	24	1	22.3	fat	1.44	0.74	nd=LOD	All_PCBs
156	meat products food	UK	sel	Scotland and Wales	total diet sample	1988	2	1	2		whole	0.21		nd=LOD	none
146	meat products food	UK	rep	Whole of UK	total diet study	1992	24	24	1	18.9	fat	0.40	0.35	nd=LOD	All_PCBs
284	meat, pork and poultry products	FR	rep	all France	rural	1998	15	1	15	24.9	fat	0.27		nd=LOD	none

Annex 3: Occurrence data for dioxins and related PCBs (concentrations in pg/g) in different food products reported by the participating countries

ID	Food	Country	rep/sel	Origin	Description	Year	No. of Samples #coll.	/pool	#anal	Fat %	basis	TEQ pg/g PCDD/F	PCB	Handling of nd's	PCB selection
337	mixed meat	SV	rep	National	mixed	1999	8	4	2	13.0	fat	0.76	0.43	nd=LOD	All_PCBs
99	mutton, fat	NL	rep	nation-wide	average	1990	80	40	2	100.0	fat	1.80	2.00	nd=LOD	nor_PCBs
288	offals (bovine liver)	FR	rep	all France	rural	1998	6	1	6	13.6	fat	3.29		nd=LOD	none
143	offals food group	UK	rep	Whole of UK	total diet study	1982	24	24	1	8.2	fat	19.17	3.33	nd=LOD	All_PCBs
155	offals food group	UK	sel	Scotland and Wales	total diet study	1988	2	1	2		whole	0.46		nd=LOD	none
144	offals food group	UK	rep	Whole of UK	total diet study	1992	24	24	1	6.1	fat	9.75	2.90	nd=LOD	All_PCBs
24	pig fat	SV	sel	national		1989	2	1	2	82.5	fat	1.38	1.18	nd=LOD	nor_PCBs
335	pig fat	SV	rep	National	mixed	1998	17	17	1	83.7	fat	0.98	0.81	nd=LOD	All_PCBs
95	pig, liver	NL	rep	nation-wide	average	1990	80	40	2	5.2	fat	15.40	2.00	nd=LOD	nor_PCBs
435	pork	DE	rep			1987	1	1	1		fat	0.28		nd=0.5LOD	none
436	pork	DE	rep			1989	3	1	3		fat	0.50		nd=0.5LOD	none
101	pork	NL	rep	nation-wide	average	1990	80	40	2	100.0	fat	0.43	0.16	nd=LOD	nor_PCBs
61	pork	FI	rep	from four biggest slaugtherhouses		1991	20	5	4		fat	0.29		nd=Zero	none
437	pork	DE	rep			1993	33	1	33		fat	0.31		nd=0.5LOD	none
439	pork	DE	rep	Bavaria		1995	10	1	10		fat	0.40		nd=0.5LOD	none
440	pork	DE	rep	nation-wide		1996	46	1	46		fat	0.17		nd=Zero	none
442	pork	DE	rep			1997	28	1	28		fat	0.37		nd=0.5LOD	none
443	pork	DE	rep	Bavaria		1997	8	1	8		fat	0.13		nd=0.5LOD	none
444	pork	DE	rep	Bavaria		1998	13	1	13		fat	0.25		nd=0.5LOD	none
237	pork	IT	rep	Imported	not specified	1999	1	1	1	56.3	fat	0.40		nd=0.5LOD	none
291	pork	NL	rep	nation wide	mixed (DNFCS)	1999	10	5	2	23.2	fat	0.23	0.09	nd=LOD	nor_PCBs
247	pork ground meat	IT	rep	Imported	wholesale	1999	1	1	1	9.4	fat	0.70		nd=0.5LOD	none
248	pork meat	IT	rep	Imported	wholesale	1999	1	1	1	9.7	fat	0.40		nd=0.5LOD	none
251	pork prosciutto	IT	rep	Imported	wholesale	1999	1	1	1	20.8	fat	3.60		nd=0.5LOD	none
250	pork salami (loin)	IT	rep	Imported	wholesale	1999	1	1	1	13.9	fat	1.20		nd=0.5LOD	none
249	pork salami (loin)	IT	rep	Imported	wholesale	1999	1	1	1	14.3	fat	0.20		nd=0.5LOD	none

Annex 3: Occurrence data for dioxins and related PCBs (concentrations in pg/g) in different food products reported by the participating countries

ID	Food	Country	rep/sel	Origin	Description	Year	No. of Samples #coll.	/pool	#anal	Fat %	basis	TEQ pg/g PCDD/F	PCB	Handling of nd's	PCB selection
239	pork, salami	IT	rep	Imported	wholesale	1999	1	1	1	29.0	fat	0.43		nd=0.5LOD	none
245	pork,ham	IT	rep	Imported	wholesale	1999	1	1	1	2.5	fat	3.80		nd=0.5LOD	none
244	pork,ham	IT	rep	Imported	wholesale	1999	1	1	1	11.0	fat	2.30		nd=0.5LOD	none
243	pork,ham	IT	rep	Imported	wholesale	1999	1	1	1	35.0	fat	0.80		nd=0.5LOD	none
246	pork,meat	IT	rep	Imported	wholesale	1999	1	1	1	6.2	fat	1.50		nd=0.5LOD	none
450	poultry	DE	rep			1993	19	1	19		fat	0.62		nd=0.5LOD	none
451	poultry	DE	rep	nation-wide		1996	17	1	17		fat	0.37		nd=Zero	none
452	poultry	DE	rep			1997	5	1	5		fat	1.08		nd=0.5LOD	none
453	poultry	DE	rep	Bavaria		1997	8	1	8		fat	0.37		nd=0.5LOD	none
26	poultry (fat)	SV	sel	national		1989	2	1	2	74.4	fat	1.30	1.55	nd=LOD	nor_PCBs
340	poultry fat	SV	rep	National	mixed	1998	9	9	1	73.0	fat	0.77	0.70	nd=LOD	All_PCBs
147	poultry food group	UK	rep	Whole of UK	total diet study	1982	24	24	1	9.2	fat	5.40	2.42	nd=LOD	All_PCBs
157	poultry food group	UK	sel	Scotland and Wales	total diet study	1988	2	1	2		whole	0.33		nd=LOD	none
148	poultry food group	UK	rep	Whole of UK	total diet study	1992	24	24	1	7.5	fat	1.68	0.93	nd=LOD	All_PCBs
446	salami	DE	rep	nation-wide		1996	20	1	20		fat	0.16		nd=Zero	none
447	sausage, boiled	DE	rep	nation-wide		1996	12	1	12		fat	0.40		nd=Zero	none
445	sausage, Frankfurter	DE	rep	nation-wide		1996	40	1	40		fat	0.17		nd=Zero	none
334	sheep	SV	rep	National	mixed	1998	10	10	1	86.1	fat	1.01	0.86	nd=LOD	All_PCBs
25	sheep (fat)	SV	sel	national		1989	2	1	2	73.2	fat	1.26	1.12	nd=LOD	nor_PCBs
93	sheep, liver	NL	rep	nation-wide	average	1990	80	40	2	7.3	fat	30.00	15.00	nd=LOD	nor_PCBs
43	swine fat	NO	rep	Norway	rural	1991	30	10	3	100.0	fat	0.20	0.71	nd=LOD	nor_PCBs
44	swine liver	NO	rep	Norway	rural	1994	30	10	3	4.9	whole	0.25	0.27	nd=LOD	mor_PCBs
454	turkey	DE	rep	Bavaria		1998	6	1	6		fat	0.56		nd=0.5LOD	none
460	veal	DE	rep			1993	11	1	11		fat	0.95		nd=0.5LOD	none
461	veal	DE	rep			1997	9	1	9		fat	0.93		nd=0.5LOD	none
252	veal fat	IT	rep	Imported	retail	1999	1	1	1	74.0	fat	0.38		nd=0.5LOD	none
236	veal fat	IT	rep	Imported	retail	1999	1	1	1	100.0	fat	1.10		nd=0.5LOD	none

Annex 3: Occurrence data for dioxins and related PCBs (concentrations in pg/g) in different food products reported by the participating countries

ID	Food	Country	rep/sel	Origin	Description	Year	No. of Samples #coll.	/pool	#anal	Fat %	basis	TEQ pg/g PCDD/F	PCB	Handling of nd's	PCB selection
235	veal fat	IT	rep	Imported	retail	1999	1	1	1	100.0	fat	0.61		nd=0.5LOD	none
238	veal/liver	IT	rep	Imported	retail	1999	1	1	1	2.8	fat	2.30		nd=0.5LOD	none
462	venison	DE	rep			1993	6	1	6		fat	1.41		nd=0.5LOD	none
	milk / milk products														
228	butter	DK	rep	Copenhagen		1987	3	1	3	79.2	fat	0.47		nd=Zero	none
377	butter	DE	rep	Germany		1987	1	1	1		fat	0.81		nd=0.5LOD	none
379	butter	DE	rep			1989	10	1	10		fat	1.90		nd=0.5LOD	none
127	butter	NL	rep	nation-wide	mixed (DNFCS)	1990	8	4	2	84.7	fat	1.79	2.11	nd=LOD	nor_PCBs
41	butter	NO	rep	Norway	retail	1991	30	10	3	81.5	whole	0.26	1.04	nd=LOD	All_PCBs
275	butter	UK	sel	Norwich	retail	1991	1	1	1		whole	1.22		nd=LOD	none
272	butter	UK	sel	Derbyshire	Retail and dairies near industrial	1991	1	1	1		whole	0.94		nd=LOD	none
383	butter	DE	rep			1993	27	1	27		fat	0.83		nd=0.5LOD	none
387	butter	DE	rep	Netherlands		1993	11	1	11		fat	0.97		nd=0.5LOD	none
388	butter	DE	rep	Germany		1993	196	1	196		fat	0.63		nd=0.5LOD	none
386	butter	DE	rep	Ireland		1993	13	1	13		fat	0.51		nd=0.5LOD	none
384	butter	DE	rep			1994	37	1	37		fat	0.68		nd=0.5LOD	none
390	butter	DE	rep	nation-wide		1995	184	1	184		fat	0.64		nd=Zero	none
393	butter	DE	rep	Netherlands		1995	13	1	13		fat	0.74		nd=Zero	none
392	butter	DE	rep	Ireland		1995	17	1	17		fat	0.40		nd=Zero	none
391	butter	DE	rep	Denmark		1995	6	1	6		fat	0.52		nd=Zero	none
389	butter	DE	rep			1995	92	1	92		fat	0.64		nd=0.5LOD	none
395	butter	DE	rep			1996	66	1	66		fat	0.55		nd=0.5LOD	none
400	butter	DE	rep			1997	55	1	55		fat	0.56		nd=0.5LOD	none
259	butter	IT	rep	Italy	retail	1999	1	1	1	16.0	fat	1.50		nd=0.5LOD	none
258	butter	IT	rep	Italy	retail	1999	1	1	1	28.5	fat	0.90		nd=0.5LOD	none
296	butter	NL	rep	nation wide	average	1999	10	5	2	91.8	fat	0.62	0.78	nd=LOD	nor_PCBs
341	butter	SV	rep	national	market basket	1999	8	8	1	85.0	fat	0.71	0.38	nd=LOD	All_PCBs

Annex 3: Occurrence data for dioxins and related PCBs (concentrations in pg/g) in different food products reported by the participating countries

ID	Food	Country	rep/sel	Origin	Description	Year	No. of Samples #coll.	/pool	#anal	Fat %	basis	TEQ pg/g PCDD/F	PCB	Handling of nd's	PCB selection
230	cheese	DK	rep	Copenhagen		1987	3	1	3	21.3	fat	2.16		nd=Zero	none
380	cheese	DE	rep			1989	5	1	5		fat	1.20		nd=0.5LOD	none
128	cheese	NL	rep	nation-wide	average	1990	8	4	2	27.2	fat	1.41	1.63	nd=LOD	nor_PCBs
276	cheese	UK	sel	Norwich	retail	1991	2	1	2		whole	0.14		nd=LOD	none
402	cheese	DE	sel			1997	1	1	1		fat	0.70		nd=0.5LOD	none
256	cheese	IT	rep	Italy	retail	1999	1	1	1	30.0	fat	0.30		d=0.5LOD	none
257	cheese	IT	rep	Italy	retail	1999	1	1	1	30.0	fat	0.60		nd=0.5LOD	none
297	cheese	NL	rep	nation wide composites	mixed (DNFCS)	1999	10	5	2	32.2	fat	0.57	0.71	nd=LOD	nor_PCBs
376	consumer milk	DE	rep	whole of Germany	rural areas	1986	8	1	8		fat	1.79		nd=0.5LOD	none
175	consumer milk	UK	rep	England (9 locations)	retail	1990	150	10	15		whole	0.07		nd=LOD	none
125	consumer milk	NL	rep	nation-wide	average	1991	8	4	2	3.5	fat	1.54	1.32	nd=LOD	nor_PCBs
382	consumer milk	DE	rep	Bavaria		1992	27	1	27		fat	0.87		nd=0.5LOD	none
126	consumer milk	NL	rep	whole country	supermarkets	1992	132	12	11	3.2	fat	1.50	1.44	nd=LOD	nor_PCBs
176	consumer milk	UK	rep	England (12 locations)	retail	1995	108	9	12	3.5	fat	1.01	1.80	nd=LOD	All_PCBs
394	consumer milk	DE	rep	Bavaria		1995	62	1	62		fat	0.55		nd=0.5LOD	none
396	consumer milk	DE	rep	Bavaria		1996	39	1	39		fat	0.51		nd=0.5LOD	none
293	consumer milk	NL	rep	nation-wide	largest factories	1997	55	5	11		fat	1.97		nd=LOD	none
399	consumer milk	DE	sel	retail, tanker lorries, indiv. farms, partly elevated levels due to citrus pulp		1997	36	1	36		fat	0.89		nd=0.5LOD	none
398	consumer milk	DE	rep	retail, tanker lorries, indiv. farms		1997	76	1	76		fat	0.62		nd=0.5LOD	none
294	consumer milk	NL	rep	nation-wide	largest factories	1998	180	4	45		fat	1.01		nd=LOD	none
287	consumer milk	FR	rep	all France (rural)	semi-skimmed	1998	149	1	149	1.8	fat	0.66		nd=LOD	none
408	consumer milk	DE	rep	Bavaria		1998	15	1	15		fat	0.46		nd=0.5LOD	none
300	consumer milk	IT	rep	imported		1999	1	1	1	3.5	fat	1.00		nd=0.5LOD	none
299	consumer milk	IT	rep	imported		1999	1	1	1	3.5	fat	0.60		nd=0.5LOD	none
295	consumer milk	NL	rep	nation-wide	supermarkets	1999	48	4	12		fat	0.51		nd=LOD	none

Annex 3: Occurrence data for dioxins and related PCBs (concentrations in pg/g) in different food products reported by the participating countries

ID	Food	Country	rep/sel	Origin	Description	Year	No. of Samples #coll.	/pool	#anal	Fat %	basis	TEQ pg/g PCDD/F	PCB	Handling of nd's	PCB selection
381	consumer milk, butter, cheese, cream	DE	rep	North-Rhine-Westphalia	dairy	1990	168	1	168		fat	1.35		nd=0.5LOD	none
385	consumer milk, butter, cheese, cream	DE	rep	North-Rhine-Westphalia	dairy	1994	120	1	120		fat	1.02		nd=0.5LOD	none
411	consumer milk, butter, cheese, cream	DE	rep	North-Rhine-Westphalia	dairy	1998	54	1	54		fat	0.67		nd=0.5LOD	none
410	consumer milk, butter, cheese, cream	DE	sel	North-Rhine-Westphalia	dairy, Farms, partly elevated levels due to citrus pulp	1998	111	1	111		fat	0.78		nd=0.5LOD	none
194	cow's milk	UK	rep	Northern Ireland	individual farms		20	1	20	3.8	fat	1.21		nd=LOD	none
227	cow's milk	DK	rep	Copenhagen	consumer milk	1987	7	1	7	2.7	fat	2.58		nd=Zero	none
27	cow's milk	SV	rep	national		1988	10	1	10	2.8	fat	2.02		nd=LOD	none
196	cow's milk	UK	sel	urban/ industrial areas	individual farms	1989	9	1	9	4.0	fat	4.99		nd=LOD	none
195	cow's milk	UK	sel	England (rural areas)	individual farms	1989	8	1	8	3.8	fat	1.27		nd=LOD	none
378	cow's milk	DE	rep	North-Rhine-Westphalia	individual farms	1989	10	1	10		fat	3.90		nd=0.5LOD	none
106	cow's milk	NL	sel	near waste incineration	industrial	1989	91	1	91		fat	4.79		nd=Zero	none
112	cow's milk	NL	sel	near metal reclamation plant	industrial	1990	20	1	20		fat	5.03		nd=Zero	none
113	cow's milk	NL	sel	Bommelerwaard	former mushroom cultivation site	1990	40	5	8		fat	1.97		nd=Zero	none
107	cow's milk	NL	sel	near waste incineration	industrial	1990	555	5	111		fat	5.21		nd=Zero	none
28	cow's milk	SV	rep	national		1990	5	1	5	3.0	fat	0.92		nd=LOD	none
197	cow's milk	UK	sel	Hampshire	urban/industrial area individual	1990	9	1	9		whole	0.15		nd=LOD	none
10	cow's milk	UK	sel	Derbyshire	ind. farms near industrial site	1990	11	1	11	4.1	whole	0.48		nd=LOD	none
204	cow's milk	FI	rep	from 12 largest dairies		1991	20	5	4	3.4	fat	0.99		nd=Zero	none
186	cow's milk	UK	sel	Derbyshire	indiv. farms near industrial site	1991	40	1	40	4.1	whole	0.27		nd=LOD	none
271	cow's milk	UK	sel	Derbyshire	retail (semi-skimmed)	1991	3	1	3		whole	0.05		nd=LOD	none
270	cow's milk	UK	sel	Derbyshire	Retail and from dairies near industrial site (full fat)	1991	8	1	8		whole	0.10		nd=LOD	none
179	cow's milk	UK	sel	Derbyshire	individual animals in suckler herd, near industrial site	1991	3	1	3	5.3	whole	5.05		nd=LOD	none

Annex 3: Occurrence data for dioxins and related PCBs (concentrations in pg/g) in different food products reported by the participating countries

ID	Food	Country	rep/sel	Origin	Description	Year	No. of Samples #coll.	/pool	#anal	Fat %	basis	TEQ pg/g PCDD/F	PCB	Handling of nd's	PCB selection
108	cow's milk	NL	sel	near waste incineration	industrial	1992	185	5	37		fat	5.74		nd=LOD	none
187	cow's milk	UK	sel	Derbyshire	indiv. farms near an industrial site	1992	9	1	9	2.8	whole	0.14		nd=LOD	none
180	cow's milk	UK	sel	Derbyshire	indiv. animals in suckler herd, near industrial site	1992	4	1	4	2.5	whole	1.46		nd=LOD	none
109	cow's milk	NL	sel	near waste incineration	industrial	1993	180	5	36		fat	6.71		nd=LOD	none
149	cow's milk	UK	sel	England	indiv. farms near industrial sites	1993	20	1	20	3.9	fat	2.01		nd=LOD	none
177	cow's milk	UK	sel	Northern Ireland	dairy (1993-1994)	1993	20	1	20	3.6	fat	1.20		nd=LOD	none
277	cow's milk	UK	sel	Derbyshire	indiv. farms near 2 industrial sites	1993	9	1	9	3.8	fat	3.23		nd=LOD	none
181	cow's milk	UK	sel	Derbyshire	indiv. animals in suckler herd, near industrial site	1993	1	1	1	1.2	whole	0.29		nd=LOD	none
188	cow's milk	UK	sel	Derbyshire	indiv. farms near an industrial site	1993	4	1	4	4.0	whole	0.10		nd=LOD	none
82	cow's milk	BE	rep	Whole Belgium	tanker lorries	1994	24	3	8		fat	2.60		nd=LOD	none
110	cow's milk	NL	sel	near waste incineration	industrial	1994	175	5	35		fat	4.85		nd=LOD	none
150	cow's milk	UK	sel	England	indiv. farms near industrial sites	1994	34	1	34	3.9	fat	2.14	2.21	nd=LOD	All_PCBs
182	cow's milk	UK	sel	Derbyshire	indiv. animals in suckler herd, near industrial site	1994	2	1	2	0.7	whole	0.21	0.15	nd=LOD	All_PCBs
189	cow's milk	UK	sel	Derbyshire	indiv. farms near an industrial site	1994	5	1	5	3.5	whole	0.11	0.14	nd=LOD	All_PCBs
83	cow's milk	BE	rep	whole country	tanker lorries	1995	54	3	18	15.3	fat	2.50		nd=LOD	none
88	cow's milk	BE	rep	whole Belgium	1995 - 1996	1995	142	1	142		fat	0.56		nd=LOD	ICES7
111	cow's milk	NL	sel	near waste incineration	industrial	1995	45	5	9		fat	2.67		nd=LOD	none
151	cow's milk	UK	sel	England	indiv. farms near industrial sites	1995	39	1	39	3.8	fat	3.57	3.20	nd=LOD	All_PCBs
190	cow's milk	UK	sel	Derbyshire	indiv. farms near industrial site	1995	2	1	2	3.6	whole	0.09	0.10	nd=LOD	All_PCBs
183	cow's milk	UK	sel	Derbyshire	ndiv. animals in suckler herd, near industrial site	1995	2	1	2	2.6	whole	0.66	0.13	nd=LOD	All_PCBs
84	cow's milk	BE	rep	whole country	tanker lorries	1996	60	3	20	14.2	fat	2.10		nd=LOD	none
152	cow's milk	UK	sel	England	indiv. farms, near industrial sites	1996	26	1	26	4.1	fat	2.99	2.58	nd=LOD	All_PCBs

Annex 3: Occurrence data for dioxins and related PCBs (concentrations in pg/g) in different food products reported by the participating countries

ID	Food	Country	rep/sel	Origin	Description	Year	No. of Samples #coll.	/pool	#anal	Fat %	basis	TEQ pg/g PCDD/F	PCB	Handling of nd's	PCB selection
191	cow's milk	UK	sel	Derbyshire	indiv. farms, near industrial site	1996	1	1	1	4.1	fat	6.03	5.38	nd=LOD	All_PCBs
184	cow's milk	UK	sel	Derbyshire	indiv. animals in suckler herd, near industrial site	1996	4	1	4	0.7	fat	62.13	11.14	nd=LOD	All_PCBs
85	cow's milk	BE	rep	whole country	tanker lorries	1997	60	3	20	4.1	fat	1.90		nd=LOD	none
397	cow's milk	DE	rep	Schleswig-Holstein	tanker lorries	1997	36	1	36		fat	0.39		nd=Zero	none
403	cow's milk	DE	rep	Lower Saxony	indiv. farms	1997	16	1	16		fat	0.45		nd=0.5LOD	none
404	cow's milk	DE	sel	Lower Saxony	tanker lorries, farms, partly elevated levels due to citrus pulp	1997	25	1	25		fat	0.91		nd=0.5LOD	none
153	cow's milk	UK	sel	Yorkshire	indiv. farms, near industrial sites	1997	17	1	17	4.0	fat	2.05	2.78	nd=LOD	All_PCBs
192	cow's milk	UK	sel	Derbyshire	indiv. farms, near industrial site	1997	20	1	20	3.8	fat	1.82	2.47	nd=LOD	All_PCBs
185	cow's milk	UK	sel	Derbyshire	indiv. animals in suckler herd, near industrial site	1997	8	1	8	1.0	fat	19.43	4.27	nd=LOD	All_PCBs
62	cow's milk	FI	rep	nation wide		1998	15	3	5	3.2	fat	0.34	0.23	nd=LOD	All_PCBs
29	cow's milk	SV	rep	southern Sweden		1998	2	1	2	3.5	fat	0.29	0.55	nd=LOD	nor_PCBs
30	cow's milk	SV	rep	national		1998	14	14	1	4.8	fat	1.10	0.53	nd=0.5LOD	All_PCBs
409	cow's milk	DE	sel	Schleswig-Holstein	tanker lorries, farms, partly elevated levels due to citrus pulp	1998	74	1	74		fat	0.52		nd=Zero	none
405	cow's milk	DE	rep	Lower Saxony	indiv. farms	1998	14	1	14		fat	0.48		nd=0.5LOD	none
406	cow's milk	DE	rep	Lower Saxony	tanker lorries	1998	29	1	29		fat	0.60		nd=0.5LOD	none
407	cow's milk	DE	sel	Lower Saxony	indiv. farms, farms, partly elevated levels due to citrus pulp	1998	24	1	24		fat	1.14		nd=0.5LOD	none
220	cow's milk	IT	rep	Germany	tanker lorries	1998	1	1	1	3.4	fat	0.34		nd=0.5LOD	none
223	cow's milk	IT	rep	Germany	tanker lorries	1998	1	1	1	3.7	fat	0.33		nd=0.5LOD	none
224	cow's milk	IT	rep	Germany	tanker lorries	1998	1	1	1	3.7	fat	0.33		nd=0.5LOD	none
221	cow's milk	IT	rep	Germany	tanker lorries	1998	1	1	1	4.1	fat	0.42		nd=0.5LOD	none
222	cow's milk	IT	rep	Germany	tanker lorries	1998	1	1	1	4.5	fat	0.26		nd=0.5LOD	none
219	cow's milk	IT	sel	France	tanker lorries	1998	1	1	1	3.9	fat	0.33		nd=0.5LOD	none
225	cow's milk	IT	rep	Germany	tanker lorries	1998	1	1	1	3.7	fat	0.27		nd=0.5LOD	none
226	cow's milk	DK	rep	Whole of Denmark	bulk tanks	1999	90	9	10		fat	0.49		nd=LOD	none

Annex 3: Occurrence data for dioxins and related PCBs (concentrations in pg/g) in different food products reported by the participating countries

							No. of Samples			Fat		TEQ pg/g		Handling of nd's	PCB selection
ID	Food	Country	rep/sel	Origin	Description	Year	#coll.	/pool	#anal	%	basis	PCDD/F	PCB		
513	dairy products	FR	rep	various regions in France	cream, butter, cheese & yoghurt	1998	126	1	126	33.9	fat	0.68		nd=Zero	none
506	milk	BE	rep	whole country	tanker lorries	1998	180	9	20	3.8	fat	2.00		nd=LOD	none
507	milk	BE	rep	whole country	tanker lorries	1999	90	9	10	3.9	fat	1.80		nd=LOD	none
401	milk products	DE	rep			1997	7	1	7		fat	0.81		nd=0.5LOD	none
9	milk food group	UK	rep	Whole of UK	total diet study	1982	24	24	1	3.5	fat	4.54	2.71	nd=LOD	All_PCBs
7	milk products food group	UK	rep	Whole of UK	total diet study	1982	24	24	1	35.2	fat	3.41	1.73	nd=LOD	All_PCBs
170	milk products food group	UK	sel	Scotland and Wales	total diet study	1988	2	1	2		whole	0.26		nd=LOD	none
140	milk products food group	UK	rep	Whole of UK	total diet study	1992	24	24	1	2.9	fat	2.06	1.26	nd=LOD	All_PCBs
8	milk products food group	UK	rep	Whole of UK	total diet study	1992	24	24	1	21.6	fat	0.75	0.56	nd=LOD	All_PCBs
342	mixture dairy	SV	rep	National	market basket	1999	6	2	3	4.5	fat	0.89	0.38	nd=LOD	All_PCBs
229	yoghurt	DK	rep	Copenhagen		1987	5	1	5	2.9	fat	3.81		nd=Zero	none
	others														
129	nuts	NL	rep	nation-wide	mixed (DNFCS)	1990	8	4	2	52.0	fat	0.26	0.06	nd=LOD	nor_PCBs

ID= identification
Origin = origin of samples
/pool = average number in each pool
TEQ PCDD/F (preferably <LOD treated as LOD)

Food = description of food
Description = description sample type
#anal. = num of (pooled) sam analyzed
TEQ PCB (preferably <LOD treated as LOD)

Country = Country abbreviation
year = year of sampling
Fat % = percentage of fat
Handling of nd's = handling of results < LOD

rep/sel = representative/selective
coll =number of samples collected
Fat basis = fat basis /whole product
PCB selection = selection of PCB's incorporated in calculation

Annex 4: Dietary intake of dioxins and PCBs, pg TEQ/day*

Country	Survey	Period	Sex/Age	Region	Occurrence data	Mean intake (pg TEQ/d) PCDD/F	PCB	total	per kg bw PCDD/F	PCB	total	Comments
Children and adolescents												
BE	Teenagers	1997	M&F 14-18	City of Ghent								only milk fat
DE	Toddlers	1995	M&F 22 mo-5 yr	North-Rhine Westphalia	1995	44.0	na		2.6	na		Duplicate study
DE	Toddlers	1998	M&F 14-47 mo	North-Rhine Westphalia	1998	22	na		1.61	na		Duplicate study
FR	National survey	1998-99	M&F 15-18	all France	1998-99	77.9	na		1.31	na		nd=LOD
FR	National survey	1998-99	M&F 3-14	all France	1998-99	72.0	na		2.28	na		nd=LOD
UK	British School-children's study	1983	M&F 10/11,14/15	all UK	1982	216.0	134.2	351	4.98	3.09	8.09	
UK	British School-children's study	1983	M&F 10/11,14/15	all UK	1992	78.5	45.4	123.9	1.81	1.05	2.85	
UK	British Toddlers study	1992/93	M&F 1.5-4.5	all UK	1982	136.4	88.8	225	9.47	6.17	15.63	
UK	British Toddlers study	1992/93	M&F 1.5-4.5	all UK	1992	48.6	31.2	79.9	3.38	2.17	5.55	

*TEF factors used, if not other stated: PCDD/F = NATO/CCMS (1988); PCB = Ahlborg et al. (1994); nd = not detected; na = not assessed

Annex 4: Dietary intake of dioxins and PCBs, pg TEQ/d*

Country	Survey	Period	Sex/Age	Region	Occurrence data	Mean intake (pg TEQ/d) PCDD/F	PCB	total	per kg bw PCDD/F	PCB	total	Comments
Adults or total population												
DK	Danish dietary habits	1985	M&F 15-80	all Denmark	1987	313.8	na					nd=0
FI	Finnrisk	1992	M&F 25-64	4 major regions	1991	95	na					nd=0
FI	Finsurvey	1997	M&F 25-64	5 major regions	1991-99	60.8	50.5	111.2	1.01	0.84	1.85	nd=LOD
FR	Dietary survey	1998-99	M&F 18-75	all France	1998-99	97.1	na		1.45			nd=LOD
IT	INN-CA 1995	1994-1996	M&F 1-92	all Italy		45.1	na		0.74			nd=0.5*LOD
DE	Report of Nutrition	1985-89	M&F adults	all Germany	1986-89	160	na		2.3			nd=0.5*LOD
DE	Report of Nutrition	1985-89	M&F adults	all Germany	1987-90	120-140	na		1.7-2.0			nd=0.5*LOD
DE	Report of Nutrition	1985-89	M&F adults	all Germany	1987-90	130	na		1.9			nd=0.5*LOD
DE	Report of Nutrition	1985-89	M&F adults	all Germany	1986-91	127	na		1.8			nd=0.5*LOD
DE	Report of Nutrition	1985-89	M&F 25-50	all Germany	1991-95	104	na		1.47			nd=0.5*LOD
DE	Report of Nutrition	1985-89	M&F adults	all Germany	1993-96	61.3	na		0.88			nd=0.5*LOD
DE	Duplicate diet study	1994	M&F adults	Saxony-Anhalt	1994	61.5	na		0.85			nd=0.5*LOD
DE	Duplicate diet study	1994-95	M&F24-64	North-Rhine Westphalia	1994-95	49	na		0.72			nd=0.5*LOD
DE	Report of Nutrition	1985-89	M&F adults	all Germany	1995	69.6	na		1.0			nd=0.5*LOD
DE	Report of Nutrition	1985-89	M&F adults	all Germany	1995-98	37	na		0.53			nd=LOD
DE	Report of Nutrition	1985-89	M&F 25-50	all Germany	1996-98	50.9	na		0.73			nd=0.5*LOD
NL	DNFCS 1987/1988	1987-1988	M&F 1-85	all Netherlands	1990-91	81.9	80.5					nd=LOD
NL	DNFCS 1992	1992	M&F 1-85	all Netherlands	1990-91	67	na					nd=LOD
NL	DNFCS 1992	1992	M&F 1-85	all Netherlands	1994-96	41	na					nd=LOD
NL	Duplicate diet	1978	M&F 21-60	one region	1978	300	491	791	4.19	6.85	11.04	nd=LOD
NL	Duplicate diet	1984-85	M&F 18-74	one region	1984-85	127	184	311	1.82	2.93	4.23	nd=LOD
NL	Duplicate diet	1994	M&F 18-74	one region	1994	40	69	109	0.53	0.92	1.45	nd=LOD
NO	NORKOST 1997	1997	M&F 16-79	all Norway		29.0	110.2	139.2				nd=LOD
SE	Riksmaten 1997-98	1997-98	M&F 18-74	all Sweden	1998-99	78	63	141	1.06	0.85	1.91	nd=LOD
SE	Market Basket				1999	79	58	138	1.07	0.79	1.87	nd=LOD
UK	British Adult Study	1986/87	M&F 16-64	all UK	1982	247.2	160.8	408	3.52	2.29	5.82	nd=LOD
UK	British Adult Study	1986/87	M&F 16-64	all UK	1992	88.3	56.5	144.8	1.26	0.81	2.07	nd=LOD

* TEF factors used, if not other stated: PCDD/F = NATO/CCMS (1988); PCB = Ahlborg et al. (1994); nd= not detected; na = not assessed

** Intake estimate based on the assumption that all fish consumed originated from the Baltic.

Annex 5: Dietary exposure of breast fed infants to dioxins and PCBs in pg TEQ/day

Country	Survey	Period	Sex Age	Region	Occurrence data	Mean intake (pg TEQ/day)			per kg bw			Comments
						PCDD/F	PCB	total	PCDD/F	PCB	total	
DE	Breast fed infants		M&F 1 mo	all Germany	1998	291			70			fully breastfed*
DE	Breast fed infants		M&F 2 mo	all Germany	1998	338			68			fully breastfed*
DE	Breast fed infants		M&F 3 mo	all Germany	1998	360			62			fully breastfed*
DE	Breast fed infants		M&F 4 mo	all Germany	1998	370			57			fully breastfed*
DE	Breast fed infants		M&F 6 mo	all Germany	1998	369			48			fully breastfed*
DE	Breast fed infants		M&F 5 mo	all Germany	1998	271			38			partly breastfed**
DE	Breast fed infants		M&F 6 mo	all Germany	1998	180			24			partly breastfed**
DE	Breast fed infants		M&F 7-9 mo	all Germany	1998	108			13			partly breastfed**
DE	Breast fed infants		M&F 4 mo	all Germany	1986-90	879			135			fully breastfed*
DE	Breast fed infants		M&F 4 mo	all Germany	1992	604			93			fully breastfed*
DE	Breast fed infants		M&F 4 mo	all Germany	1994	502			77			fully breastfed*
DE	Breast fed infants		M&F 4 mo	all Germany	1996	402			62			fully breastfed*
UK	Breast fed infants	1978/80	M&F2 mo	Cambridge	1993/4	503	268					fully breastfed
UK	Breast fed infants	1978/80	M&F3 mo	Cambridge	1993/4	533	284					fully breastfed
UK	Breast fed infants	1978/80	M&F4 mo	Cambridge	1993/4	531	283					fully breastfed
UK	Breast fed infants	1978/80	M&F5 mo	Cambridge	1993/4	487	259					partly breastfed
UK	Breast fed infants	1978/80	M&F6 mo	Cambridge	1993/4	396	211					partly breastfed
UK	Breast fed infants	1978/80	M&F7 mo	Cambridge	1993/4	335	178					partly breastfed
UK	Breast fed infants	1978/80	M&F8 mo	Cambride	1993/4	238	127					partly breastfed
UK	Breast fed infants	1978/80	M&F10 mo	Cambridge	1993/4	218	116					partly breastfed

* Dioxin intakes have been calculated on the basis of the mean body weight, the average intake of breast milk depending on the age of the infants, and assuming a fat content of human milk to be 3.5%.

** Dioxin intake calculated using the German nutritional recommendations for infants, and assuming that the recommended amount of milk is breast milk.