# DIETARY INTAKE OF DIOXINS AND DIOXIN-LIKE PCBS BY THE GENERAL POPULATION OF TEN EUROPEAN COUNTRIES. RESULTS OF EU-SCOOP TASK 3.2.5 (DIOXINS)

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## Introduction

This paper summarizes the results of Scientific Co-operation (SCOOP) Task 3.2.5, a European project that has been co-ordinated by RIVM in Bilthoven, the Netherlands, and NFA in Uppsala, Sweden. The project has been carried out at the request of the Commission of the European Communities 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 dioxin-like PCBs in foods, and the resulting dietary exposure of the general population. The PCBs selected 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). This 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).

The human exposure to dioxins and related compounds has been the subject of various international studies conducted in the past few years [1,2]. A significant part of the SCOOP database includes the same information as published in the before mentioned reports. However, it also contains more recent material resulting from studies conducted until the end of 1999. In addition, it contains information on dioxin-like PCBs, which were not taken into consideration in the other reports.

## Methodological aspects

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. 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. For calculations of TEQs, the TEFs according to NATO/CCMS [3] and Ahlborg et al. [4] were used.

**Results and Discussion**

Occurrence in foods

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. The current database can be considered relatively complete for PCDDs and PCDFs, but rather incomplete for dioxin-like PCBs.

The current database shows national average concentrations of PCDDs and PCDFs in eggs, fats and oils, meat (products) and milk (products) of generally less than 1 up to 2-3 pg I-TEQ/g fat. PCDD and PCDF levels in fish ranged between 0.25 and 10-20 pg I-TEQ/g on whole weight 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 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.

Occurrence in Human Milk

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).

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 the SCOOP 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.*

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.

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