

## MONITORING DIETARY EXPOSURE TO DIOXINS AND PCBs IN THE UK

Alison Gleadle, Martin Gem, Nigel Harrison

Food Standards Agency, P.O. Box 31037, London, SW1P 3WG, U.K.

### Introduction

The UK has developed a cost-effective approach to assessing and monitoring trends in exposure to dioxins and PCBs based on analysis of the UK Total Diet Study (TDS) samples<sup>1,2</sup>. The TDS is an important part of the UK Food Standards Agency programme of surveys for chemicals in food and has been carried out on a continuous annual basis since 1966. Results from the TDS are used to estimate dietary exposures of the general UK population to a variety of chemicals in food, to identify trends in exposure and to make assessments on the safety and nutritional quality of the UK food supply.

Analysis of the TDS samples is supplemented by surveys for dioxins and PCBs in individual foodstuffs, such as milk<sup>3</sup> and fish<sup>4</sup>. These provide important additional information on variations in concentrations. The data are also used to estimate dietary exposure of UK consumers from the consumption of specific foods; the contribution to exposure from the remainder of the diet can also be taken into account, based on TDS data.

Data for dioxins and dioxin-like polychlorinated biphenyls (PCBs) in the TDS samples for 1982 and 1992 indicated that estimated dietary exposures of UK consumers to dioxins and dioxin-like PCBs fell substantially in that period. Work is in progress to provide new exposure estimates based on analysis of the 1997 TDS samples.

### Methods and Materials

The design of the UK TDS has been described in detail elsewhere<sup>1,2</sup>, but basically involves 119 categories of food products combined into 20 groups of similar foods for analysis. Food product samples for the TDS are purchased at intervals throughout each year from 24 randomly selected locations in the UK. The food products are prepared as for consumption and then composited into samples of each food group for each location. The food group samples are stored in a stable condition. Due to the analytical costs, the composite samples of each food group from each location are further composited prior to analysis for dioxins and PCBs, so that a single sample is analysed for each food group.

Food products are grouped into food group samples so that commodities known to be susceptible to contamination (e.g. offals, fish) are kept separate, as are foods which are consumed in large quantities (e.g. bread, potatoes, milk). The relative proportion of each food product within a TDS food group reflects its importance in the average UK household diet and is based on an average of three previous years of data from the National Food Survey (NFS)<sup>5</sup>. The NFS data is based on the types and quantities of food purchased by households, supplemented by import and trade statistics, and is updated annually. For example, to determine the amounts and relative proportions of foods making up the 1997 TDS, an average of the 1993, 1994 and 1995 NFS data were used. In earlier years, the NFS did not take account of food consumed outside the home, but this is now taken into account.

For the 1982 and 1992 TDS, analysis was restricted to the 11 food groups considered likely to contribute most to the estimated dietary exposure to dioxins and dioxin-like PCBs. These eleven groups were selected either because they have significant fat content (e.g. milk, meat, fish), and/or because they are consumed in large amounts by the majority of the population (e.g. milk, bread). Dietary exposures from the remaining food groups (fruit, vegetables, sugar and nuts) were

estimated by assuming that each dioxin and dioxin-like PCB was present in each of those food groups at its limit of determination. In contrast, all food groups with the exception of the beverage food group, 19 in total, are being analysed for the 1997 TDS.

The analytical methodology for determining dioxins and PCBs concentrations in food has been reported previously<sup>6</sup>. All analytical data are assessed for compliance with published acceptance criteria<sup>7</sup>. Typically, all the 17 dioxins and the 14 dioxin-like PCBs congeners to which a WHO-TEF has been assigned are included. Generally, the following additional PCBs congeners are also analysed: PCB 18, 28, 31, 47, 49, 51, 52, 99, 101, 128, 138, 180 and 153. These additional congeners were selected as they have other non-dioxin-like toxic effects, are routinely analysed elsewhere and/or are commonly reported to occur in food and/or in human milk. The concentrations reported and dietary exposures calculated from them are *upper bound* values (i.e. <LOD=LOD).

### Results and Discussion

Two types of dietary exposures are estimated from the results of analysis of TDS food group samples (i) population exposure and (ii) consumer exposure. Both approaches to estimating exposure have their limitations.

- *Population exposure estimates.*

Combining data on the amounts of foods consumed, based on consumption data from the appropriate years of the NFS, with the corresponding concentration of dioxins and dioxin-like PCBs in each TDS food group provides an estimate of population average exposure (covering both adults and children) for that year. Comparisons with similarly derived estimates from previous TDS studies enable trends in dietary exposures of the general UK population to be followed. These estimates take into account changes both in consumption of the various foods making up the general UK diet and in concentrations of dioxins and PCBs in these foods between different TDS studies. However, the NFS does not provide information on who within a household actually eats the food purchased, nor of wastage, and estimates of high level dietary exposure cannot be made using the NFS.

- *Consumer exposure estimates.*

Dietary exposures of UK consumers to dioxins and dioxin-like PCBs are estimated from concentrations in TDS food group samples in combination with consumption data from the British Adult Study<sup>8</sup> and the British Schoolchild Study<sup>9</sup> and the British Toddler Study<sup>10</sup>. The British Adult and Toddler Studies, weighed diary (4 or 7 day) studies of nationally representative samples drawn from different population age groups, have been carried out as part of the National Diet and Nutrition Survey (NDNS) programme, sponsored jointly by the Food Standards Agency and the Department of Health. Unlike the NFS, the British Adult, Schoolchild and Toddler Studies take account of consumption by individuals. However, exposures estimated using these dietary surveys do not take account fully of changes in individual dietary habits that may have occurred over a period as each dietary survey has only been carried out once to date. A new survey of the eating habits of UK adults began in July 2000.

Consumption of toddler-specific foods is not yet taken into account in exposure estimates generated from TDS surveys because linking these foods with the appropriate TDS food group within the exposure estimation computer programme has not been completed. When the results of the 1982 and 1992 TDS surveys were originally published, provisional estimates of toddler exposures were made on the assumption that the variety and proportions of foods eaten by toddlers were the same as those of the foods eaten by adults. The use of consumption data from the British Toddler Study is considered to provide a more robust interim estimate of dietary exposure and this approach will be used from now on. Estimates of dietary exposures for individuals who eat average amounts of each food group (mean consumers) and those who eat significantly more than average (upper range [97.5th percentile] consumers) are considered. It is

these estimates of consumer dietary exposure that are compared with safety guidelines when assessing any possible risk to human health.

Concentration data, and estimated dietary exposures of UK consumers estimated from them, are available for the 1982 and 1992 TDS<sup>11</sup>. The estimated dietary exposures of all age groups fell sharply between 1982 and 1992. Provisional data only and more up-to-date exposure estimates are currently available for the 1997 TDS (see Figure 1). Final data are currently in preparation for publication<sup>12</sup>.

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Figure 1: Estimated average UK adult dietary exposure to dioxins and dioxin-like PCBs

