DIOXIN IN MEAT, MILK AND DAIRY PRODUCTS: DIETARY INTAKE IN ITALY

Gianfranco Diletti[1], Beatrice Creati[1], Loredana Annunziata[1], Alessandro Ripani[1], Giampiero Scortichini[1]

[1]Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise

Introduction

Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) are ubiquitous toxic contaminants, highly lipophilic compounds that bioaccumulate in animal tissues. It is well established that food intake represents the main route of human exposure to these contaminants (more than 90%). In particular, the major source of PCDD/Fs in the diet seems to be represented by fat-containing animal products. Since the consumption of meat and dairy products contributes about 40-60% to the average exposure of the general population, this study was focused on meat, milk and dairy products[1,2,3,4,5,6,7]. From 1998 the WHO has revised the health risks of PCDD/Fs and recommended a tolerable daily intake (TDI) range of 1-4 pg WHO-TEQ/kg body weight. Besides, the Scientific Committee on Food of the European Commission has established a tolerable weekly intake (TWI) for dioxins of 14 pg/kg body weight. In Italy, from 2000 to 2003, PCDDs and PCDFs monitoring was conducted according to the National Residues Surveillance Plan (NRSP) and all relevant laboratory tests were carried out at the Istituto Zooprofilattico Sperimentale Abruzzo & Molise (ISO/IEC 17025 accredited), following designation by the Ministry of Health. Aim of this paper is to estimate the dietary intake of PCDD/Fs by the Italian population taking into account meat, milk and dairy products.

Methods and Materials

According to 2000-2003 NRSP sampling plan, a total of 350 samples (see Table 1 for details) were collected by the regional veterinary services, covering the national territory.
After fat extraction and acid/base partitioning a further purification was performed according to EPA Method 1613 Rev B that was adapted to food samples and related contamination levels[8,9].
All samples were analysed by high-resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS); the mass spectrometer was operated with EI ionisation in the selected ion monitoring (SIM) mode at a resolution of 10000. The HRGC/HRMS system consisted of a ThermoFinnigan MAT 95XL spectrometer coupled to a ThermoQuest Trace Series 2000 gas chromatograph. TEQ values were calculated using WHO-TEFs[10]. According to the European legislation, WHO-TEQs were calculated as upper bound concentrations assuming that all values of specific dioxins congeners below the limit of determination (LOD) are equal to the respective LOD. Daily food consumption data were collected from FAOSTAT website[11].

Daily dietary intake was calculated by means of average and 95th percentile assuming a 60 kg body weight.

Results and discussion

Contamination levels of PCDD/Fs in meat, milk and dairy products are shown in Table 1. The mean dioxin content on whole product was higher in milk than in meat. Concerning meat samples, beef was the most contaminated product. The congener profiles of PCDD/Fs in meat, milk and dairy products are presented in Fig. 1. The levels and congener profiles of dioxins were comparable to those reported in literature[1,7,12,13,14,15,16]. The concentration of PCDFs decreased with the increasing number of chlorine substitution, while OCDD was the prevalent congener among PCDDs, followed by 1,2,3,4,6,7,8-HpCDD.

The PCDDs/PCDFs ratio was similar in beef and pork (60/40 and 61/39, respectively), while PCDDs were more abundant in chicken (79/21). Finally, milk and dairy products showed an equivalent amount of dioxins and furans (54/46).

The daily intake values of PCDD/Fs for the considered food are summarised in Table 2. The dietary intake was comparable to those calculated in Spain[17] and Belgium[7] while lower values were obtained from studies carried out in other European countries[18]. In the present study, milk and dairy products were the food that mainly contributed to dioxins/furans assumption, whereas chicken meat gave the lowest intake, as shown in Fig. 2. The individual congeners intake for the considered food are presented in Fig. 3. Although OCDD and 1,2,3,4,6,7,8-HpCDD were present in the highest concentrations, the principal contribution to the TEQ intake was due to 2,3,4,7,8-PeCDF, 1,2,3,7,8-PeCDD and 2,3,7,8-TCDD. The obtained results demonstrated that the risk of assuming dioxins through the diet in Italy is below the TDI value. Dioxin contamination in other food groups should be investigated in order to perform an overall risk assessment.

References

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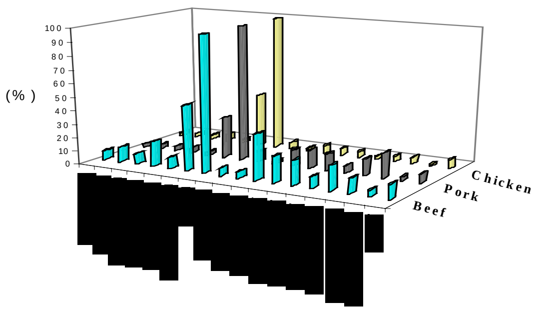
Table 1: PCDD/Fs levels (pg WHO-TEQ/g fresh weight) in meat and milk/dairy samples

Food	N° of samples	Mean	Median	Min	Max	95th percentile
Chicken	67	0.018	0.015	0.003	0.069	0.044
Beef	61	0.031	0.020	0.003	0.161	0.069
Pork	99	0.027	0.008	0.002	0.680	0.053
Milk and dairy products	123	0.044	0.022	0.002	0.709	0.140

Table 2: Average and 95th percentile (upper bound) dietary intake for PCDD/PCDFs

Food	Consumption (g/day)	Average (pgWHO-TEQ/kg bw/day)	95th percentile (pgWHO-TEQ/kg bw/day)
Chicken	49.9	0.015	0.037
Beef	62.5	0.032	0.072
Pork	116.4	0.052	0.103
Milk and dairy products	137.0	0.100	0.320
Total		**0.20**	**0.53**

Fig. 1 PCDD/Fs congener profiles in meat and milk/dairy samples (normalised)



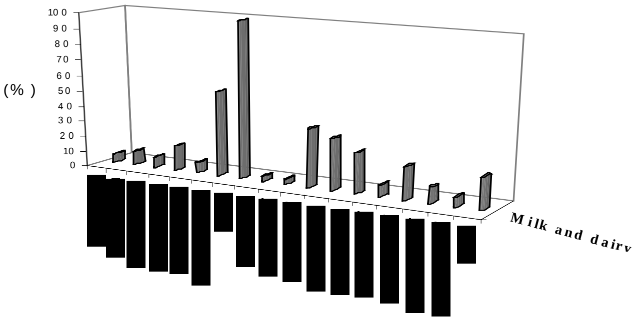


Fig. 2 Relative contribution of meat and milk/dairy to the dietary intake

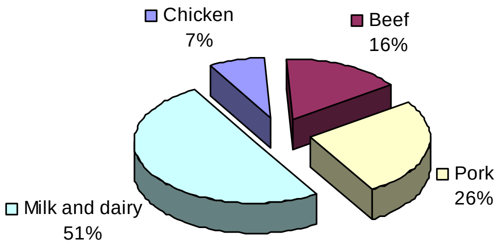


Fig. 3 Contributions of individual PCDD/Fs to the dietary intake - pg WHO-TEQ/day (A) and pg/day (B)