RETROSPECTIVE AND PROSPECTIVE INTAKE ASSESSMENT OF PERFLUORINATED CHEMICALS WITHIN THE EUROPEAN UNION: THE PERFOOD PROJECT

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Introduction

Perfluorinated chemicals (PFAS) are an emerging group of priority pollutants, that enter into the feed/food chains, as main consequence of the environmental quality where food production activities are carried out, and/or of the food processing – food delivery systems (cooking, packaging, serving). On regional basis, this may determine a diverse grade of intake, accounting for the geographical origin of food and for the different food habits among Countries. Within this framework the EU Commission granted the PERFOOD project to assess the PFAS intake in the main four geographical areas of the EU, and to trace the sources of such contaminants in the food chain, and, more recently prompted Member States to activate monitoring plans able to provide data for a sound exposure assessment[1] . This paper deals with the methodology adopted in the PERFOOD project, related to the intake assessment.

Materials and methods

The first step was to perform a retrospective assessment of the dietary exposure to PFAS of the general European population; to this purpose, occurrence of contaminants of interest in food and national average food consumption data are needed. The national databases (updated at the end of 2009) from the following Countries representing North, West, East and South Europe, respectively, were achieved: Belgium, Czech Republic, Germany, Italy, Nederland, Norway, Sweden, United Kingdom, and Europe[2]. Food consumption detailed databases have been harmonised mostly according to the food categories indicated by EFSA[3]. Because the available data were not directly comparable, data grouping has been harmonised (mostly according to the indication of EFSA Datex unit), to match the food categories and sub-categories (see Table 1), and to get more comparable food consumption data from different Countries. This basically consisted on: a) some food items have been classified under a different food group from that reported in the national database (i.e. all soft drinks were included among "water" group); b) the consumption of some composite food items, reported on wet weight, has been expressed on dry weight: in the case of bread and tea, this meant to subtract the contribution of water; c) the expression of the data has been harmonised and referred to a daily consumption for a 62 kg bw person.

As regards occurrence data of PFAS in food, in the first phase of the project (retrospective assessment) only PFOS and PFOA were taken in consideration as for other perfluorinated substances the number of data available in the scientific literature was not sufficient for a sound exposure calculation. Databases used by EFSA for its opinion[4] on PFOS and PFOA were updated and integrated as former data were referred only to "Fish and fishery products" and "Drinking and surface water" categories, data for drinking water were mainly derived from environmental samples of freshwater (87 %) and tap and bottled water contribution was limited to 17 % of the samples. Therefore, peer-reviewed data coming from international publications and national reports on PFAS intake studies, available within the PERFOOD Consortium and referred to all food items, were added. However, because some samples of surface water are referred to sites under environmental pressure with no information about the possible water

captation for drinking purposes, in our retrospective estimation we have considered only those values referred to tap water samples.

Results and discussion

The retrospective assessment is summarised in Table 1 and Figure 1. Preliminary results indicate that the average intake on deterministic basis in the selected EU countries is 45.7 ng/kg bw per day and 32.0 ng/kg bw per day for PFOS and PFOA, respectively, against a PFOS TDI of 150 ng/kg bw per day and a PFOA TDI of 1500 ng/kg bw per day. Tap water contributes up to 65 % for PFOS (mean contribution: 50%) and to 84 % for PFOA (mean contribution: 73%) to the dietary intake, whereas fish and fishery products average contribution to daily intake is up to 31 % for PFOS.

The observed regional/local differences in both occurrence and intake (Table 2), in some way could be reflected in the outcomes from bio-monitoring studies[5].

Prospective studies: according to the retrospective occurrence and food consumption databases, prospective studies have been targeted to: 1) a sampling carried out on regional basis with a full description of samples, with particular attention paid to the representativeness of tap water samples[6]; 2) reduce the uncertainties related to: poor information about occurrence of PFAS in some categories of raw and processed food, accounting also for their composition; 3) reduce the analytical uncertainties derived from inadequate LOQs, with respect to the food category consumption database, thus allowing a more consistent use of left-censored data[7]. To this purpose minimum required LOQs have been proposed for each food category accounting for their relevance in contributing to the intake assessment with respect to TDI values provided for PFOS and PFOA; sampling and analysis of cauldrons of known composition to assess contribution from packaging and processing system with respect to the background levels present in raw foods; 5) correlation between intake studies and biomonitoring evidences on pharmacotoxicokinetics basis to evaluate the contribution of the diet to the aggregate exposure and the possible relevance of sources other than food (indoor dust, carpeting and clothing).

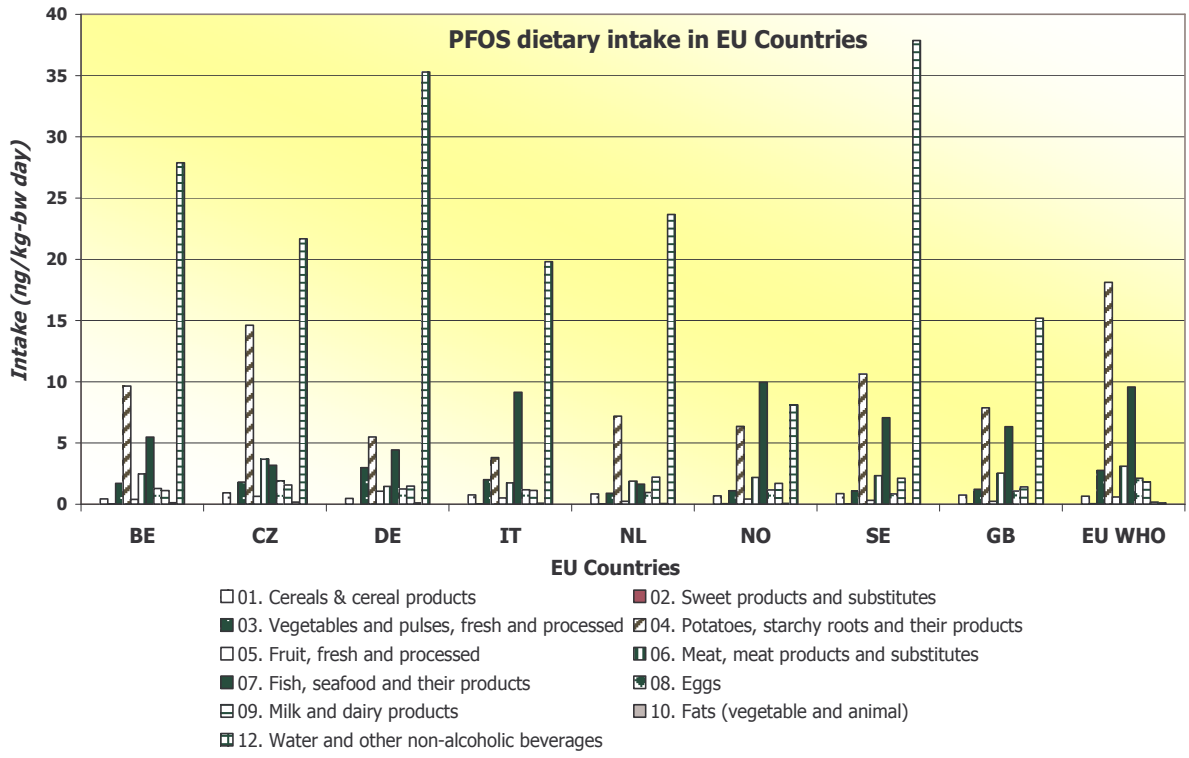
Table 1. PERFOOD statistical descriptors of PFOS and PFOA occurrence (ng/g whole weight) in EU food items based on samples obtained from 2001 onward. In italics the medium bound values ("0.5 × LD") derived from limits of determination.

Food categories	PFOS					PFOA				
	N	% of LD	mean	sd	range	N	% of LD	mean	sd	range
01. Cereals & cereal products	9	78%	0.183	0.239	0.0017-*0.5* [a]	9	67%	0.246	0.221	0.005-*0.5*
02. Sweet products and substitutes	27	96%	0.021	0.096	*0.002-0.5*	25	96%	0.025	0.099	0.0014-*0.5*
03. Vegetables and pulses, fresh and processed	39	49%	0.556	1.64	0.00017-10	40	48%	0.589	0.860	0.0018-4.1
04. Potatoes, starchy roots and their products	11	55%	4.64	9.58	0.001-28	12	42%	0.698	0.768	0.0053-2.2
05. Fruit, fresh and processed	13	62%	0.150	0.251	*0.0085* -0.7	13	54%	0.390	0.445	*0.018* -1.6
06. Meat, meat products and substitutes	58	40%	0.973	1.45	*0.000745* -5.36	56	63%	0.753	1.99	*0.001* -11.4
07. Fish, seafood and their products	221	18%	12.7	27.8	0.013-230	144	58%	0.692	1.98	0.002-15
08. Eggs	16	44%	3.50	7.09	*0.01* -22	14	50%	0.867	1.34	*0.016* -5.0
09. Milk and dairy products	25	56%	0.351	1.02	0.0023-*5.0*	24	54%	0.062	0.139	*0.0005-0.5*
10. Fats (vegetable and animal)	4	100%	*0.142*	0.240	*0.015-0.5*	4	100%	*0.171*	0.225	*0.0015-0.5*
11. Miscellaneous	1	100%	*0.500*	—	—	1	100%	*0.500*	—	—
12. Water (ng/L)	26	58%	1.72	1.96	0.071-8.1	27	52%	1.75	1.59	0.400-6.8
13. Coffee, tea, infusions (ng/L)	1	100%	*<0.03*	—	—	1	0%	9.50	—	—
14. Alcoholic beverages	4	75%	*5.85*	4.87	*0.65-10*	4	75%	*19.2*	34.0	*0.4* -70

Table 2. PERFOOD statistical descriptors of PFOS and PFOA levels (ng/g whole weight) in EU fish and seafood grouped in the four EU macroareas.

	PFOS				PFOA			
	Central EU	East EU	North EU	South EU	Central EU	East EU	North EU	South EU
mean value	13.7	42.8	0.925	1.14	1.22	0.135	0.040	0.551
min	0.039	12.0	0.013	0.025	0.002	—	0.024	0.014
max	230	136	2.80	13.0	8.00	—	0.051	15.0

Figure 1. PFOS preliminary dietary intake in European countries. Among the EU average data, the contribution of "Water and non-alcoholic beverages" is missing.



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