Investigation into Mixed Halogenated Dioxins, Furans and Biphenyls in food

Area of research interest: Chemical hazards in food and feed
Study duration: 2008-07-01
Project code: C01050
Conducted by: The Food and Environment Research Agency

Background

Mixed halogenated dioxins, furans and biphenyls can be formed during combustion when both bromine and chlorine are present. They have previously been reported in the environment but there have been no investigations for their presence in food. There are thousands of potential congeners, of which several hundred may be toxicologically significant, making their analysis very difficult. The purpose of this project was to develop and validate the necessary methodology and obtain the necessary laboratory standards with which to determine whether it is possible to detect mixed halogenated congeners in foods and to gain an indication of their prevalence compared with the ubiquitous chlorinated (and much less common brominated) equivalents.

Research Approach

Based on current methodology for dioxins and PCBs, which uses carbon fractionation followed by gas chromatography-high resolution mass spectrometry, the sample extraction and clean-up was adapted to ensure that the fraction containing the congeners of interest was clear of interferences and the detection parameters were optimised to achieve the necessary selectivity and sensitivity for detection of mixed halogenated congeners. The method was validated using the same criteria as for chlorinated dioxins and PCBs. Finally, it was be applied to a range of samples held from previous investigations or obtained specially to test the methodology. About 100 samples of fish, shellfish, meat, offal, eggs and dairy produce were tested for the presence of six mixed dioxins, seven mixed furans and six mixed biphenyls (all for which appropriate standards are available).

Results

The adapted methodology was successfully validated. Detection limits similar to those for dioxins were achieved. The presence of mixed halogenated dioxins, furans and biphenyls in foods was demonstrated. Furans were detected more frequently than dioxins, with the most frequently-occurring congeners found in more than half of all samples. Mixed halogenated biphenyls were found in almost all samples, with mono-bromo analogues of PCB 118 and PCB 126 almost ubiquitous. In the case of PCB 126, the mono-brominated analogue occurred most frequently, followed by its di-bromo analogue, but even the tri-bromo analogue was found in about 15% of samples. TEQs for the mixed congeners were estimated using TEFs for chlorinated analogues. Based on whole weight, in fish the total TEQs for mixed represented less than 1% of the TEQ for chlorinated, although this was based on only a proportion of the potential mixed congeners for any chlorinated equivalent. In shellfish, the mixed were 1-5% of the chlorinated analogues with a

similar ratio in offal. Based on fat weights, TEQs for mixed were similarly in single figure percentages for meat, eggs and dairy products.

Published Papers

Two papers are in preparation

Research report

England, Northern Ireland and Wales

PDF
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