PCDD/F AND PCB CONCENTRATIONS IN COWS' MILK FROM FARMS ON FLOODPLAINS OF RIVERS IN ENGLAND AND WALES

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Introduction

It is widely known that milk from cows grazing in the vicinity of pollution sources may contain elevated levels of polychlorinated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs) and polychlorinated biphenyls (PCBs). Contamination of soil in pastureland is known to occur on the floodplains of contaminated rivers[1]. This study was designed to determine the direct effect of any such contamination on milk from cattle grazing on floodplain land.

Materials and Methods

A Geographical Information System (GIS) was used to assist in the identification of suitable sampling sites[2]. Digital map data on rivers, elevation and land cover were integrated with grid references of farms registered with Milk Marque (a national dairying co-operative). Preliminary maps were produced for nine river systems in Wales, the Midlands and Northern England.

The Dee, Trent, and Doe Lea/Rother/Don River systems were selected as having a high density of Milk Marque dairy farms and covering a range of rural, urban, and industrialised environments. Maps showing the locations of the rivers and their tributaries are displayed in Figure 1. Samples of milk, soil and grass were taken from 38 dairy farms (either with floodplain pastures or acting as nearby control locations) in autumn 1998, spring 1999 and summer 1999. The sampling methods used have been described previously[3]. Flood events were monitored in each area.

Samples were analysed for PCB congeners (IUPAC Numbers) 77, 81, 126, 169 (non-ortho); 28, 31, 105, 114, 118, 123, 128, 156, 157, 167, 189 (mono-ortho); 18, 47, 49, 51, 52, 99, 101, 138, 153, 170, 180 (di-ortho) and the seventeen 2,3,7,8–substituted PCDD/Fs. Full details of the analytical and quality control procedures adopted have been presented elsewhere[4,5].

Results

Analysis of the samples collected is still in progress. Results for milk samples collected in Autumn 1998 from the 17 farms with floodplain pastures are shown in Table 1. The contribution to WHO-TEQs[6] from PCDD/Fs, non-ortho PCBs, and ortho PCBs are listed, as well as the total WHO-TEQ.

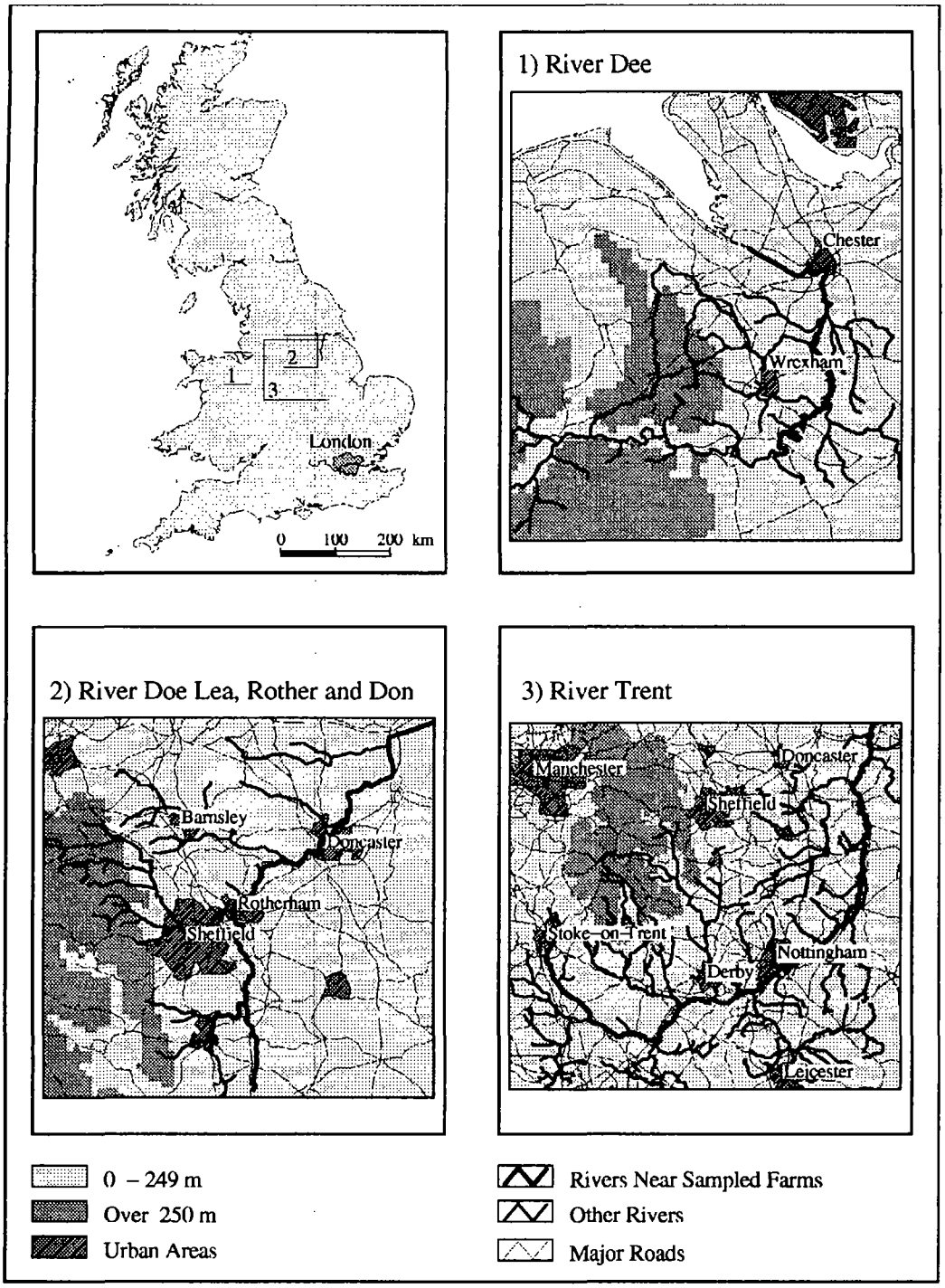

Figure 1: The locations of the sampled river systems.

Table 1: WHO-TEQs in milk from floodplain farms in Autumn 1998.

River	Sample ID	PCDD/Fs	Non-Otho PCBs	Ortho PCBs	Total TEQ
River Dee	3155	1.00	2.18	0.15	3.33
	3157	0.71	1.41	0.17	2.29
	3163	0.92	0.78	0.18	1.88
	3154	0.94	0.58	0.17	1.69
Rivers	3160	1.89	0.96	0.24	3.09
Doe Lea	3166	2.60	0.75	0.24	3.59
Don and	3156	2.38	0.66	0.36	3.40
Rother	3168	3.05	2.04	0.40	5.49
	3162	5.96	0.63	0.79	7.38
	3164	4.26	1.37	0.46	6.09
River Trent	3159	2.05	3.17	0.25	5.47
	3158	3.87	4.46	0.17	8.50
	3153	2.60	1.75	0.32	4.67
	3161	1.49	1.36	0.23	3.08
	3152	3.19	2.04	0.33	5.56
	3167	3.90	1.52	0.32	5.74
	3165	1.21	1.56	0.25	3.02

Note: TEQs are upper bound levels in ng/kg fat

Discussion

Samples of milk from all four farms on the Dee had concentrations of PCCD/Fs at around typical UK background values. The Dee had been selected as a relatively clean, control river system and these results confirmed its suitability for this function.

Samples of milk from two farms on the Doe Lea/Rother/Don river system had concentrations of more than 6 ng/kg fat total WHO-TEQ. One of the farms was known to be close to a source of contamination and to have elevated PCDD/F concentrations in its milk[7]. However, milk from the other farm had not previously been analysed. It may be significant that this farm had pasture that was known to flood regularly, and upon which cattle graze for long periods of the year.

Results from the Trent floodplain displayed a wide range of concentrations - from background to 8.5 ng/kg fat on a total WHO-TEQ basis. The latter level was higher than any concentration from the Doe Lea/Rother/Don rivers. This sample and that from a neighbouring farm had contributions to their WHO-TEQ from the non-ortho PCB content of the milk of 52.5% and

57.9% respectively. Taken overall, the mean contributions to the total TEQ from the non-ortho PCBs were 53.9% for the River Dee, 25.4% for the Doe Lea/Rother/Don, and 44.0% for the Trent.

Conclusions

The results of the analyses carried out to date suggest that the patterns of PCDD/Fs and PCBs in milk vary from one river system to another and indicate that the non-ortho PCBs constitute a significant proportion of the overall WHO-TEQ for many of the samples. Source attribution of the various PCDD/F and PCB components is not feasible at this stage of the project.

In addition to the results reported in this paper, milk, soil and herbage samples were also taken from designated control farms (i.e. not prone to flooding) in Autumn 1998. Further sampling was undertaken at all farms in Spring and Summer 1999. It is anticipated that these additional samples will provide the data required to assess the impact that cow's diet and general grazing environment may have on concentrations of PCDD/Fs and PCBs in milk.

Acknowledgements

We would like to thank Quentin Smith of Milk Marque for helping to arrange the initial contacts with dairy farmers. This work is funded by the UK Food Standards Agency. The opinions expessed are those of the authors alone.

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