IMPACT OF FOOT AND MOUTH DISEASE ANIMAL PYRES ON PCDD/Fs and PCBs IN LOCALLY PRODUCED FOOD

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Introduction

To control the outbreak of foot and mouth disease (FMD) which occurred in the UK in February 2001, a large number of farm animals were slaughtered. Where it was not possible to render or landfill the carcasses, they were destroyed by burning on pyres with wood, coal and other materials. Uncontrolled combustion is known to produce small quantities of PCDD/Fs.

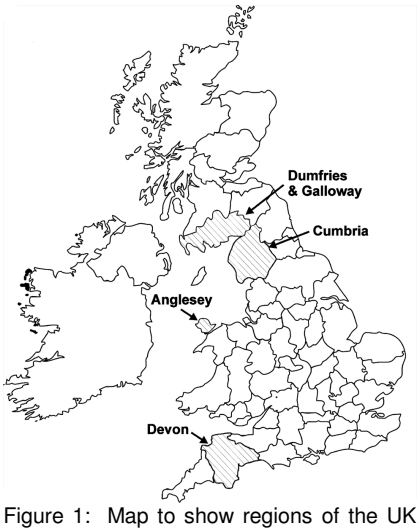

Figure 1: Map to show regions of the UK worst affected by FMD in 2001

Based on concentrations of PCDD/Fs in air predicted by a modelling exercise[1], it was concluded that exposure to these compounds from the pyres via the diet would be minor compared to background dietary exposure. There were, however, large uncertainties in parts of the model, and so a programme of monitoring for PCDD/Fs and PCBs in food produced in the vicinity of the pyres was put in place to establish the risks posed to consumers.

Reports were published by the Food Standards Agency as soon as results became available, with interim reports in July[2], August[3] and September 2001[4] and a final report in January 2002[5].

Surveys for PCDD/Fs and PCBs have been conducted in the UK since 1989, and data exists for a variety of food samples in addition to Total Diet Study (TDS) samples for 1982, 1992 and 1997[6].

Methods and materials

Samples

Foodstuffs including eggs, milk, milk products, chickens, lambs, trout, animal feed and rhubarb were collected from farms generally downwind from the pyres, and also from control sites remote from any pyre. Up to 6 rounds of samples of milk were taken over the duration of the outbreak, from the same farms or areas, which should have identified any increased exposure via the transfer of these contaminants from pyre to grass and then milk.

The analytical methodology used was based on that reported previously. Farms from which samples were collected were chosen on the basis of number and type of animals burned in nearby

pyre(s), topography, and geographical information, wind speed and direction when the pyres were burning, areas covered by prohibition orders and data on farm type and location. Some samples of grain and other poultry feed were also taken from some farms. Milk was sampled from bulk tanks on the farms. Between 1 and 12 hen or duck eggs, depending on availability, were combined into single composite samples for each farm and egg type. All samples were homogenised and lyophilised prior to analysis.

Results and discussion

Results are shown in Table 1.

Milk: PCDD/Fs and PCB concentrations in milk were comparable to data found for milk from previous surveys. Milk from the different sampling rounds showed no evidence of accumulation of these compounds as a result of the pyres. Concentrations in the control samples were similar to those in milk from close to the pyres. The dioxin-like PCB concentrations in some samples from Cumbria and Dumfries and Galloway were slightly elevated and the congener profile for these compounds was also unusual. Previous and subsequent samples from the same farms did not exhibit this feature, suggesting that the source of this anomaly could be linked to the temporary feeding regimes used in this period. Cattle were kept indoors as far as possible as the pyres burnt, and there might have been several changes in feed-stocks during the periods between sampling rounds. Samples from 2 farms in Anglesey contained elevated concentrations of PCBs. This is discussed below with the results for eggs.

Eggs: Concentrations of PCDD/Fs and PCBs in hen eggs from Devon, Carmarthenshire and Dumfries and Galloway were within the expected range for free range eggs. In Anglesey, elevated concentrations of PCBs (but not PCDD/Fs) were found in eggs from a single producer. The eggs from the affected farm are used for breeding exhibition birds only and do not enter the food chain. Slightly elevated concentrations of PCBs were also found in milk from 2 of 3 farms in the same area. Since PCBs are not known to be produced in large quantities during combustion, it was unlikely that the pyre was the source of any contamination. Further samples of hen and duck eggs were taken and the second sample of hen eggs had higher concentrations of both PCDD/Fs and PCBs. The PCDD/F content was not unusual for free range eggs but the PCBs in the hen egg samples accounted for about 87 % of the combined TEQ value, whereas 50 % is more typical. The eggs in the two sampling rounds were however from different breeds of birds. The Environment Agency and local council are carrying out further investigations at the farm. Eggs from other farms within 5-10 km showed no sign of unusual PCB contamination, nor did grain fed to the hens or soil or herbage collected from near the farm.

Chickens: Four chickens were analysed from around pyres in Dumfries and Galloway. 2 laying hens from the same site were found to have elevated concentrations of PCDD/Fs. A third sample, a cockerel from the same area had lower PCDD/F concentrations. A fourth sample from a farm in a different area of Dumfries and Galloway analysed later contained elevated PCB concentrations, but PCDD/Fs were comparable with those of the poultry group from the 1997 TDS. Eggs from the same flocks contained the expected concentrations of PCDD/Fs and PCBs. Additional samples taken of chickens from the supplier farm, eggs, feed (barley and layers pellets), soil and vegetation were within expected ranges. Further investigations did not identify any potential source of PCDD/Fs and PCBs or any explanation of the results found. The contamination was specific to the hens sampled and confined to a single farm. There were no wider food chain implications.

Lamb: Samples of meat from lamb were obtained, one each from around pyres in Carmarthenshire, Anglesey and Devon, and control samples from different parts of Anglesey and Carmarthenshire. The results for muscle from the lambs grazing near the pyre in Carmarthenshire were slighhtly elevated compared with the carcase meat food group of the 1997 TDS and the other lambs tested. The results for the ewes' kidney and ewes' liver were comparable with those of the offals food group from the 1997 TDS..

Other foods: Results for cheese, butter, ice cream and clotted cream were comparable with the milk products food group of the 1997 TDS. Results for goats' milk samples from Dumfries and Galloway were similar to those found for cows' milk and showed no accumulation of PCDD/Fs and PCBs in later sampling rounds. Trout samples were within the range found in an earlier survey.[10] Rhubarb was very low with many congeners present at concentrations below the analytical limit of determination.

Animal feed, soil and herbage: The results for samples of animal feed analysed as part of this exercise were within the expected ranges for compound animal feeding stuffs. Those for soil and herbage, taken and analysed by the Environment Agency, were all within the expected ranges.

Conclusions

With few exceptions, concentrations of PCDD/Fs and PCBs were within expected ranges predicted by reference data. No accumulation over time of PCDD/Fs and PCBs in milk as a result of the pyres was evident from the repeat milk sampling exercise. Where elevated concentrations of PCDD/Fs and PCBs were found in chicken and eggs, they were in samples not destined for the food chain. Slightly elevated PCB concentrations in milk from Dumfries and Galloway were not found in earlier or later samples. Where slightly elevated concentrations of PCDD/Fs and PCBs were found in lamb from Carmarthenshire, the lambs sampled were very young and would not have entered the food chain. There was no evidence that the FMD pyres were responsible for any increase in concentration of PCDD/Fs and PCBs.

Acknowledgement

This work was funded by the UK Food Standards Agency.

References

1. Foot and mouth. Effects on health of emissions from pyres used for disposal of animals. Risk assessment undertaken by: Department of Health, Department of Environment, Transport and the Regions, Food Standards Agency, Environment Agency and AEA Technology, available at www.doh.gov.uk/fmdguidance
2. Food Standards Agency (2001) Dioxins and dioxin-like polychlorinated biphenyls in foods from farms close to pyres. *First report*. Food Standards Agency, available at www.food.gov.uk/multimedia/pdfs/dioxinreport1.pdf
3. As (2) *Second report*. available at www.food.gov.uk/multimedia/pdfs/dioxinreport2.pdf
4. As (2) *Third report*. available at www.food.gov.uk/multimedia/pdfs/dioxinreport3.pdf
5. Food Standards Agency (2002) Report on dioxins and dioxin-like polychlorinated biphenyls in foods from farms close to foot and mouth disease pyres. *Final report*. Food Standards Agency.
6. Rose, M, White, S, Harrison, N, and Gleadle, A. (2001) *Organohalogen Compounds* **52** 143-146
7. Krokos, F, Creaser, CS., Wright, C. and Startin, JR. (1997) *Fesenius Journal of Analytical Chemistry*. **357**, 732-742
8. Ambidge, P, Cox, EA, Creaser, CS, Greenberg, M, Gem, MG, Gilbert, J, Jones, PW, Kibblewhite, MG, Levy, J, Lisseter, SG, Meredith, TJ, Smith, L, Smith, P, Startin, JR, Stenhouse, I and Whitworth, M. (1990) *Chemosphere* **21** 999-1006
9. Robinson, C, Rose, M, White, S, Gem, M, Gleadle, A, and Harrison, N**.** (2000) *Organohalogen Compounds* 47 378-381.

Table 1: Concentrations of dioxins and dioxin-like PCBs in food and feed collected from the vicinity of FMD pyres

Sample details	No	Concentrations (ng WHO-TEQ/kg fat) Dioxins	Dioxin-like PCBs	Dioxin & PCBs Total
i a) **Cows' Milk**				
1 cw	4	0.4 (all)	0.5 (all)	0.8 to 0.9
1 dv	11	0.4 to 0.8	0.3 to 1.8	0.8 to 2.4
2 dv	10	0.4 to 0.7	0.4 to 1.5	0.8 to 2.2
3 dv	9	0.4 to 0.9	0.4 to 1.5	0.8 to 2.0
1 cb	11	0.4 to 0.8	0.4 to 0.9	0.8 to 1.7
2 cb	10	0.5 to 0.8, 0.7, 0.5, 0.8	0.4 to 1.0, 1.4, 2.3, 3.2	1.0 to 1.7, 2.2, 2.8, 3.9
3 cb	10	0.5 to 0.9	0.4 to 0.5	0.9 to 1.4
1 ag	3	0.5, 0.7, 1.4	0.4, 0.5, 1.2	0.9, 1.2, 2.5
2 ag	3	0.4, 0.6, 1.6	0.5, 2.9, 3.0	0.9, 3.5, 4.6
3 ag	2	0.4, 0.5	0.6, 0.6	1.0, 1.1
C 1 s	1	0.5	0.4	0.9
C 2 cl	1	0.6	0.6	1.1
C 3 ag	1	0.7	0.4	1.1
1 cd	4	0.4 to 0.8	0.5 to 0.9	0.9 to 1.7
2 cd	4	0.7 to 0.9	0.4 to 0.8	1.1 to 1.6
1 dg	4	0.4 to 0.5	0.4 to 3.3	0.9 to 3.8
2 dg	4	0.4 to 0.8	0.4 to 0.6	0.9 to 1.4
3 dg	4	0.4 to 0.7	0.5 to 5.2	1.0 to 5.8
4 dg	4	0.4 to 0.6	0.4 to 1.2	1.1 to 1.6
5 dg	4	0.5 to 0.8	0.5 (all)	1.0 to 1.2
6 dg	2	0.5, 0.6	0.5, 0.6	1.0, 1.1
C 1 s	1	0.7	0.3	1.0
i b) **Goats' milk**				
1 dg	1	0.5	0.4	0.8
2 dg	1	0.6	0.9	1.5
3 dg	1	0.5	0.8	1.3
4 dg	1	0.7	0.4	1.1
5 dg	1	0.7	0.5	1.1
ii a) **Hens' Eggs**				
1 ag	1	4.3	29	34
2 ag	1	10	82	92
C ag	2	6.7, 5.8	1.4, 2.4	8.1, 8.2
cm	1	3.8	1.7	5.5
dv	2	0.6,1.5	0.4, 1.3	1.0, 2.8
dg	5	1.6 to 5.4	1.3 to 8.5	2.8 to 14
ii b) **Ducks' eggs**				
1 ag	1	6.1	9.7	16
2 ag	1	4.1	11	15
cm	1	4.5	2.2	6.6
C cm	1	1.7	1.13	2.9
iii) **Meat**	8	0.5 to 2.4, 3.2, 39, 40	0.4 to 2.7, 12, 3.1, 1.6	0.5 to 5.1, 15, 42, 42
Chicken dg				
Chicken C dg	1	0.4	0.6	1.0
Lamb meat C gd	2	0.5, 0.7	1.0, 1.7	1.6, 2.1
Lamb kidney C gd	1	0.7	0.6	1.3
Lamb liver C gd	1	13.5	3	16.5
Lamb kidney ag	1	0.7	0.7	1.3
Lamb liver ag	1	19	3.7	23
Lamb meat ag	2	1.1, 1.4	0.6, 0.7	1.7, 2.1
Lamb meat C cm	2	8.2, 3.4	3.3, 1.4	11.5, 4.8
Lamb meat cm	2	3.5, 2.7	1.8, 1.3	5.3, 4.0
Lamb kidney dv	1	0.4	0.4	0.9
Lamb meat dv	2	0.8, 1.0	0.6, 0.6	1.4, 1.6
iv) **Other foods**				
Clotted cream cw	1	0.3	0.5	0.8
Cheese dg	4	0.4 to 0.5	0.3 to 0.5	0.8 to 0.9
Cheese C dg	1	0.4	0.4	0.8
Butter dg	1	0.6	0.5	1.1
Ice cream dg	2	0.3, 0.3	0.6, 0.5	0.8, 0.7
Trout dg	2	4.7, 6.6	13, 16	18, 22
Trout fillets dg	2	5.9, 15	17, 34	22, 49
Rhubarb dg	1	0.03	0.02	0.05
v) **Animal feed**				
Poultry – Grain ag	1	0.1	<0.1	0.1
Poultry - Grain dg	1	<0.1	<0.1	0.1
Poultry-Layer pels dg	1	<0.1	<0.1	0.2
Poultry - fish pel.s dg	2	1.2, 1.8	2.2, 2.9	3.3, 4.7

1	First round	C	Control	cb	Cumbria
2	Second round	cw	Cornwall	Ag	Anglesey
3	Third round etc	dv	Devon	gd	Gwynedd (for Anglesey)
				cd	County Down
				dg	Dumfries & Galloway
				cm	Carmarthenshire

Organohalogen Compounds, Volume 63, Dioxin 2003, Boston, MA