Environmental Protection Agency

Dioxin Levels in the Irish Environment: Sixth Assessment (Summer 2008)

Based on levels in Cows milk

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

Headquarters, PO Box 3000
Johnstown Castle Estate
County Wexford, Ireland

Ceanncheathrú, Bosca Poist 3000
Eastát Chaisleán Bhaile Sheáin
Contae Loch Garman, Éire

T:+353 53 916 0600
F:+353 53 916 0699

Regional Inspectorate
McCumiskey House, Richview
Clonskeagh Road, Dublin 14, Ireland

Cigireacht Réigiúnach, Teach Mhic Chumascaigh
Dea-Radharc, Bóthar Cluain Sceach
Baile Átha Cliath 14, Éire

T:+353 1 268 0100
F:+353 1 268 0199

Regional Inspectorate
Inniscarra, County Cork, Ireland

Cigireacht Réigiúnach, Inis Cara
Contae Chorcaí, Éire

T:+353 21 487 5540
F:+353 21 487 5545

Regional Inspectorate
John Moore Road, Castlebar
County Mayo, Ireland

Cigireacht Réigiúnach, Bóthar Sheán de Mórdha
Caisleán an Bharraigh, Contae Mhaigh Eo, Éire

T:+353 94 904 8400
F:+353 94 902 1934

Regional Inspectorate
Seville Lodge, Callan Road,
Kilkenny, Ireland

Cigireacht Réigiúnach, Lóiste Sevilla,
Bóthar Challainn, Cill Chainnigh, Éire

T:+353 56 779 6700
F:+353 56 779 6798

Regional Inspectorate
The Glen, Monaghan, Ireland

Cigireacht Réigiúnach, An Gleann
Muineachán, Éire

T:+353 47 77600
F:+353 47 84987

E: info@epa.ie
W: www.epa.ie
Lo Call: 1890 33 55 99

Printed on an environmentally friendly paper stock

Dioxin Levels in the Irish Environment

Sixth Assessment
(Summer 2008)

Based on Levels in Cows' Milk

Colman Concannon

December 2009

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhsaoil
PO Box 3000, Johnstown Castle, Co. Wexford, Ireland

Telephone: +353 53 60600 Fax: +353 53 60699
Email: info@epa.ie Website: www.epa.ie

Lo Call 1890 33 55 99

DIOXIN LEVELS IN THE IRISH ENVIRONMENT

Sixth Assessment
(Summer 2008)

Based on Levels in Cows' Milk

Published by the Environmental Protection Agency, Ireland

ISBN 978-1-84095-339-8

Acknowledgements

The EPA is indebted to Mr. George Kearns, Irish Co-operative Organisation Society Ltd. and to the management and staff of the individual co-operatives and dairies without whose co-operation this survey would not have been possible.

Particular thanks are due to Dr Rainer Grümping of Gesellschaft für Arbeitsplatz und Umweltanalytik (GfA) in Münster, Germany and to his staff for carrying out the sample analysis and for much expert advice during the survey.

Finally, the author wishes to thank the staff of the individual regional inspectorates of the Environmental Protection Agency who took the samples and also those other colleagues who advised and assisted in the preparation of this report.

CONTENTS

EXECUTIVE SUMMARY

Background

In order to maintain surveillance of dioxins, furans and other micro pollutants, the Environmental Protection Agency carried out in Summer 2008 a follow-up survey to the 1995, 2000, 2004, 2006 and 2007 surveys of dioxin in cows' milk (EPA 1996, EPA 2001, EPA 2005, EPA 2008 (1) and (2)).

"Dioxins" is a collective term for the category of 75 polychlorinated dibenzo-para-dioxin compounds (PCDDs) and 135 polychlorinated dibenzofuran compounds (PCDFs). Seventeen PCDD and PCDF compounds are considered to be of toxicological significance.[1] The most toxic of these is 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). The toxic responses include dermal effects, immunotoxicity and carcinogenicity, as well as reproductive and developmental toxicity. These compounds, or congeners, arise mainly as unintentional by-products of incomplete or poorly controlled combustion and from certain chemical processes.

Given that the primary mechanism for dioxins entering the food chain is through atmospheric deposition, cows' milk is considered to be a particularly suitable matrix for assessing their presence in the environment, since cows tend to graze over relatively large areas and these compounds will, if present, concentrate in the fat content of the milk.

In accordance with current practice, testing for dioxin-like polychlorinated biphenyls (PCBs) was included for each sample.

In view of increased international awareness of the issue of the presence in the environment of brominated flame retardants (BFRs) and brominated dioxins, it was decided to repeat the 2006 and 2007 sampling for these substances at the same time as the dioxin survey. Five samples, representative of different regions, were analysed. Each sample consisted of three pooled samples from the dioxin survey.

Sources of Dioxins

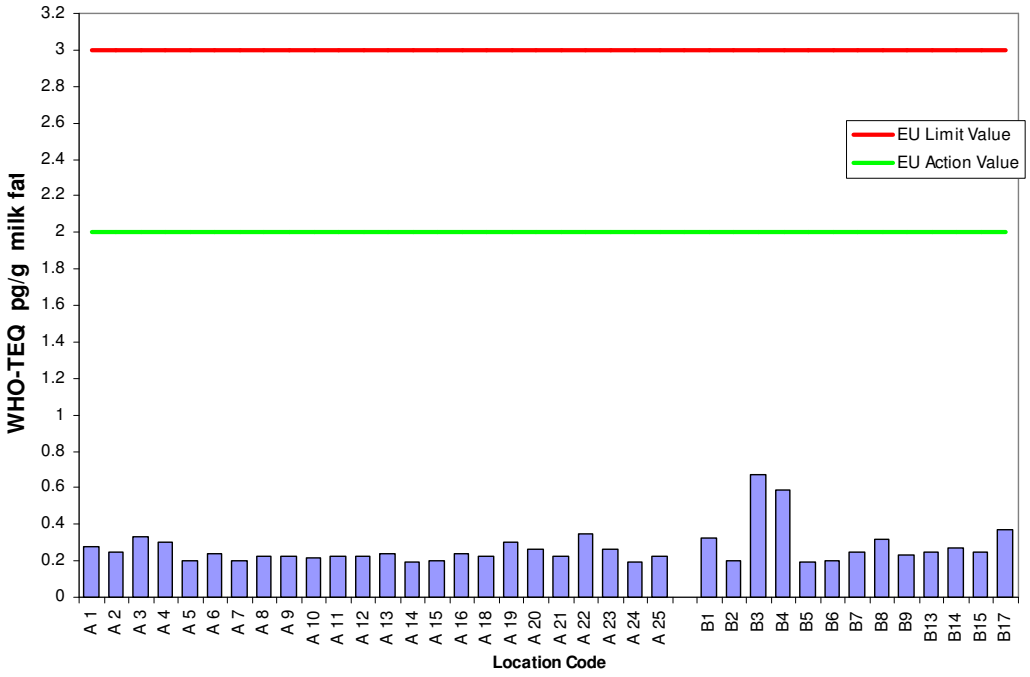
Although PCDDs and PCDFs are not produced intentionally except for research and analysis purposes, their formation is often a by-product of many anthropogenic and natural activities. Some significant sources internationally are:

- Accidental fires
- Backyard burning of household waste and bonfires
- Cement kilns (especially where hazardous waste is co-incinerated)
- Chlorine bleaching of wood pulp
- Coal fired power plants
- Copper production
- Forest fires and other natural fires
- Incineration of medical waste
- Incineration of municipal or hazardous waste
- Production of steel
- Residential combustion (especially where treated wood is used)
- Sinter plants
- Traffic

Brominated dioxins (PBDDs and PBDFs) are also formed unintentionally, mainly through incineration of wastes or accidental fires that include consumer products containing brominated flame retardants (BFRs).

[1] Those 17 compounds with chlorine atoms at the 2,3,7 and 8 positions

Figure 1 Dioxins/Furans
2008 Data



Sampling and Results

Two types of sampling stations were chosen:

Type A background stations covering the entire country (24 samples)
Type B potential impact stations in areas of perceived potential risk (13 samples)

The reported ranges for dioxins in milk fat (37 samples) were 0.190 to 0.673 pg WHO-TEQ[2]/g with a mean of 0. 269 WHO-TEQ/g. When PCBs were included, the ranges are 0.304 to 0.835 pg WHO-TEQ/g with a mean of 0.440 WHO-TEQ/g.

BFRs and brominated dioxins (PBDD/PBDF) were also measured as part of the main survey. A broad range of the common BFRs was tested but only Polybrominated Diphenyl Ethers (PBDEs) were found. The range for PBDEs (5 samples) was 57 to 144 ng/kg fat with a mean of 93 ng/kg fat, comparing favourably with earlier surveys. These levels are relatively low by international comparisons.

[2] *See Glossary for explanation of terms*

Conclusions

1. The levels of dioxins found in the 2008 surveys are well below the EU limit in milk and milk products of 3.0 pg WHO-TEQ/g for dioxins only (Figure 1), and 6.0 pg WHO-TEQ/g for dioxins and PCBs combined. The results are also in line with earlier similar EPA surveys[3] and in line with earlier surveys.

2. All levels recorded in this survey compare favourably with those taken from a random selection of similar studies in EU and other countries.

3. The Brominated Flame Retardants (BFR) data were low by international comparisons and showed lower levels than earlier surveys.

4. There was no evidence to link the data from the survey to the Pork feed contamination incident near Carlow in late 2008.

[3] *See Table 4, p. 24*

1. INTRODUCTION

Background

"Dioxins" is a collective term for the category of 75 polychlorinated dibenzo-para-dioxin compounds (PCDDs) and 135 polychlorinated dibenzofuran compounds (PCDFs). These compounds or congeners arise mainly as unintentional by-products of incomplete or poorly controlled combustion and from certain chemical processes.

In line with the Environmental Protection Agency's intention to maintain surveillance of dioxins, furans (collectively known as PCDD/F) and other micro pollutants, the Agency carried out a follow-up survey to the 1995, 2000, 2004, 2006 and 2007 surveys of dioxin in cows' milk (EPA 1996, EPA 2001, EPA 2005, EPA 2008 (1) and (2)) in Summer 2008. 37 samples were taken and the sample locations were nominally the same as for the earlier surveys. However, in some instances, because of the recent rationalisation of the dairy industry, it was not always possible to sample in exactly the same location as previously, so that direct comparison of individual sampling points should be made with caution. As in earlier surveys, testing for dioxin-like polychlorinated biphenyls (PCBs) was also included in this programme.

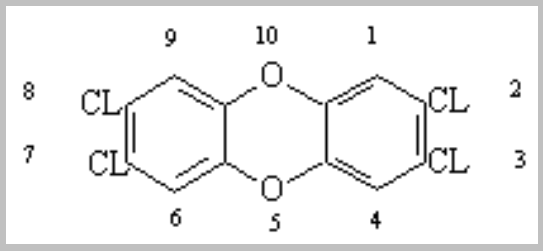
It is generally accepted that the principal mechanism of environmental release of dioxins in this country is by low level emission from multiple sources to the atmosphere. Due to their physical and chemical properties, dioxins tend to be adsorbed onto dust and soot particles. These in turn are deposited by atmospheric fallout on soil and vegetation such as grass, which is directly ingested by grazing cows. Owing to their lipophilic and persistent properties, PCDD/F are transferred into the milk fat of the lactating cow. Therefore, milk constitutes an efficient and rapid elimination pathway of these contaminants. If milk production is exclusively based on grazing, the resulting PCDD/F levels in cows' milk reflect the atmospheric PCDD/F deposition on the pasture. Dioxin levels in milk samples taken during the grazing season can therefore be used as indicators for the actual average local dioxin exposure by atmospheric deposition.

In view of increased international awareness of the issue of the presence in the environment of brominated flame retardants (BFRs) and brominated dioxins and furans (PBDD/F), it was decided to take the opportunity to sample for these substances at the same time as the dioxin survey. Five samples, representative of different regions, were analysed. Each sample consisted of three pooled sub-samples from the dioxin survey.

Samples were taken in June and July 2008 when the cows could be expected to be grazing outdoors. Details are given in Tables 1 and 2.

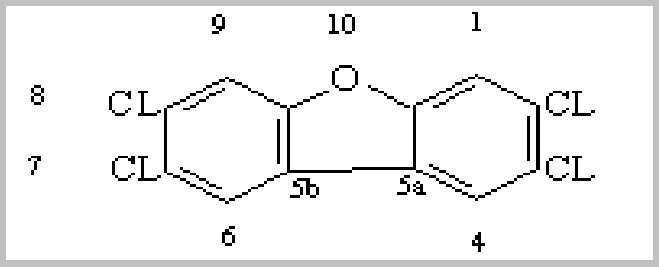
Toxicity of Dioxins

The toxicity of individual dioxin and dibenzofuran compounds (or congeners) varies considerably. PCDDs have two benzene rings connected by two oxygen atoms; in the PCDFs the two rings are connected by one oxygen atom. The PCDD and PCDF congeners which are likely to be of toxicological significance are those 17 congeners with chlorine atoms at the 2,3,7 and 8 positions. The most toxic dioxin is 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD).



2,3,7,8-TCDD

The most toxic dibenzofuran is 2,3,7,8-tetrachloro-dibenzofuran (2,3,7,8-TCDF) which is similar in toxicity to 2,3,7,8-TCDD.



2,3,7,8-TCDF

The toxic responses include dermal effects, immunotoxicity and carcinogenicity, as well as reproductive and developmental toxicity.

Mechanism of Toxicological Action

A broad variety of data, primarily on TCDD but also on other members of the class of dioxin-like compounds, has shown the importance of the Aryl hydrocarbon Ah (dioxin) receptor in mediating the biological effects of dioxin. These data have been collected using many experimental models in multiple species and also from studies on human exposure.

Sources of Dioxins

PCDDs and PCDFs are not produced intentionally except for research and analysis purposes, but their formation is often a by-product of many anthropogenic activities. The manufacture of some chlorinated compounds is known to result in the formation of PCDDs and PCDFs as unwanted by-products. However the manufacture and usage of many such substances, mainly chlorinated pesticides with significant dioxin contamination, is now banned. Internationally the main sources of dioxins in recent years have been identified as a wide range of combustion processes where they may be formed when organic materials and chlorine compounds are burned together**.** These processes can be more efficient if the precursor* chemicals are already present in a form that is close to that found in dioxins and dioxin-like PCBs. For example, organic chlorine may be more readily converted to dioxins and dioxin-like PCBs than inorganic chlorine. Aromatic[4] chemicals are more readily converted to dioxins and dioxin-like PCBs than aliphatic[4] substances. Such sources can include incineration of all types of wastes, metallurgical operations such as smelting and scrap metal recovery furnaces and the burning of fuels such as coal, wood (especially where the wood contains preservatives) and petroleum products. Other sources are motor vehicle emissions especially heavy diesel trucks (U.S. EPA 2006) and emissions from both accidental and natural fires and volcanoes. Emissions from leaded fuels, which were significant in the past, have almost disappeared. Sources such as bonfires and illegal or uncontrolled burning of domestic waste, according to research conducted in the UK (Dyke and Coleman, 1997) and by U.S. EPA (Gullett et al, 2000) are also significant although obviously difficult to quantify.

For many countries in Europe the main source of dioxins in the past was emissions from poorly controlled municipal solid waste (MSW) incinerators. However, the introduction of strict controls on emissions has resulted in the closure of many old incinerators which could not be upgraded. In the UK for example, total emissions from MSW incineration plants, which were the major source of dioxin emissions in 1990 at 600 g I-TEQ, were reduced to around 2 g I-TEQ by 1999, corresponding to less than 1% of all UK releases (DEFRA 2001). A recent report from the UK Health Protection Agency (HPA) reviewed research on the links between emissions from municipal waste incinerators and effects on health. It concluded that modern and well managed municipal waste incinerators make only a very small contribution to local concentrations of air pollutants and any potential damage to the health of those living close-by is likely to be very small, if detectable. (HPA 2009). There are no municipal solid waste incinerators operating in Ireland.

Domestic coal fires are also believed to be a relatively significant source of dioxin emissions, particularly when domestic waste, plastic or treated wood is used on these fires. The burning of damp fuel, including unseasoned logs, and of salt-laden wood from coastal areas can give rise to increased dioxin emissions (DEFRA 2006). Dioxins are also found in paper products arising from the bleaching with chlorine of naturally occurring phenols present in wood pulp and in the manufacture of some chlorinated compounds.

A well known example of an accident involving release of dioxins was the explosion in 1976 at Seveso, Italy, where some of the contents of a 2,4,5-trichlorophenol manufacturing plant were released into the atmosphere causing severe local contamination with trichlorophenol and 2,3,7,8- TCDD. Dioxins also attracted particular attention during the Vietnam War where they were found to be present as a contaminant in the defoliant Agent Orange, a mixture of 2,4,5-T and 2,4-D. High levels of dioxins were found in poultry and eggs from Belgium in 1999. The cause of the contamination is thought to have been contamination of animal feed. In July 2007,

[4] *See Glossary for explanation of terms*

the European Commission issued a health warning to its Member States after high levels of dioxins were detected in a food additive - guar gum, produced from the seeds of the guar bean, - used as thickener in small quantities in meat, dairy, dessert or delicatessen products. The source was traced to a shipment of guar gum from India that was contaminated with pentachlorophenol (PCP), a pesticide subject to severe restrictions in EU countries. PCP generally contains dioxins as a contaminant. (EC 2008). An even more recent incident occurred in Ireland in late 2008 where routine testing of the food chain found pig feed and pork tainted with PCBs and dioxins. The Irish government, as a result, ordered a recall of all domestically produced pork products from the market. The investigation into the incident is still ongoing but it has been traced to the alleged burning of PCB contaminated oil at a single pig feed recycling plant. Uncontrolled burning of some common PCB mixtures can give rise to the efficient formation of certain dibenzofuran compounds.

Dioxin compounds have no commercial value and have never been intentionally synthesised other than for laboratory use. Monitoring data for dioxins date only from the 1970s as the analytical capabilities for their detection did not exist before then due to the extremely low concentrations at which they were present in the environment. However, there can be little doubt that dioxins formed from anthropogenic activities have existed, at least to some extent, as long as there has been fire.

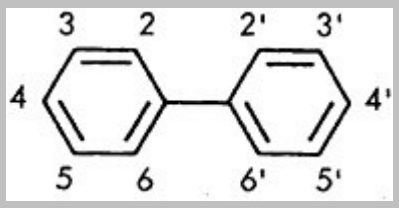
Until relatively recently, very little firm information on dioxin emission sources existed for Ireland. Accordingly the EPA commissioned a desk study to provide an estimate of dioxin emissions to air, land and water during the calendar year 2000 and also an estimate of projected emissions in 2010 (Hayes & Marnane 2002). The study also attempted to quantify significant dioxin sources in Ireland. The report estimated that in 2000, notwithstanding the inherent uncertainties of the calculations, more than half of all air emissions could be attributed to domestic burning of waste. In a nationwide investigation by the EPA it was estimated that 287,000 tonnes of household waste, representing 700,000 persons, was uncollected in 2003. In addition 80% of Local Authorities have identified backyard burning as a significant issue, especially in rural areas where a local waste collection may not be available (EPA 2005b). Hayes & Marnane also identified building fires, household heating, cooking with fossil fuel and iron and steel production as the main other sources of dioxin emissions in 2000. The sole iron and steel production facility in the State has since closed.

Considerable efforts have been made in recent times to minimise illegal waste and backyard burning. These include the Department of Environment's Race against Waste campaign, the EPA media campaigns on backyard burning and illegal waste collection, the "Dump the Dumpers" and the "See Something, Say Something" phone hotlines. These measures were highlighted as examples of good practice in waste minimisation at a recent EU "Expert Workshop on Dioxin Emissions from Domestic Sources" (http://www.bipro.de/dioxin-domestic/sub/meetings.htm. This meeting also emphasised the importance of awareness programmes in Member States regarding appropriate fuel and appliance use and issues such as dioxin release from backyard burning were also highlighted. Very recently these initiatives were enhanced by new Waste Management Regulations which make more explicit the offence of disposal of waste by uncontrolled or unregulated burning, including backyard burning of household waste. (DOEHLG 2009)

It may also be anticipated that measures to improve energy efficiency put in place through the National Climate Change Strategy 2007-2012, with a increased focus on wasteful fuel consumption and waste management and consequent emphasis on non-combustion energy alternatives, will also tend to have a positive impact on dioxin levels in the future.

Toxicity of PCBs

Polychlorinated biphenyls (PCBs) are chlorinated hydrocarbons which were synthesised by direct chlorination of biphenyl but whose production has now been discontinued. PCBs consist of a biphenyl (two benzene rings with a carbon to carbon bond between carbon 1 on one ring and carbon 1' on the second ring) with a varying number of chlorine atoms substituting for hydrogen atoms on the biphenyl rings.



Basic PCB structure

Depending on the number and location of the chlorine atom substituents, there are 209 possible PCB congeners. Some PCB congeners have a “coplanar” structure with the two biphenyl rings lying in the same plane. Of these, there are 12 mono-ortho (chlorine in 2 or 6 position in structure above) and non-ortho substituted PCBs which show similar toxicological properties to dioxins and are often termed “dioxin-like PCBs”.

Unlike dioxins, PCBs have found widespread use in a number of commercial open and closed applications, due to their physical and chemical properties, such as non-flammability, chemical inertness, high boiling points and high dielectric constants. Typical open applications have been their use in pigments, sealants, rubber products and carbonless copy paper. Closed applications have included use of PCBs in hydraulic and heat transfer systems, transformers and capacitors. The production and use of PCBs has been discontinued for some years but because of their persistent qualities they remain in electrical equipment, buildings and the environment. Dioxins and furans are often found in appreciable quantities as contaminants in PCBs.

Toxic Equivalency Factors (TEFs) for Assessing Mixtures of Dioxins and Dioxin-like Compounds

Because real samples containing dioxins are made up of complex mixtures, a system of Toxic Equivalents has been developed in order to address the problem of reporting of differing toxicities and environmental behaviour of these substances. This procedure uses a scheme of weighting factors which expresses the toxicity of each individual PCDD and PCDF in terms of

an equivalent amount of the congener 2,3,7,8-TCDD. This weighting factor, called a toxic equivalent factor (TEF), is multiplied by the concentration of the individual compounds in a mixture to give a 2,3,7,8-TCDD toxic equivalent, (TEQ) which is the sum of the concentrations of the individual congeners multiplied by their TEFs. The TEFs for the various PCDD, PCDF and dioxin-like PCB congeners are listed in Annex 1.

Systems for Establishing TEFs

A number of different systems for establishing toxic equivalent factors now exist. The NATO/CCMS (North Atlantic Treaty Organisation's Committee on Challenges of Modern Society) I-TEQ system which was used in the EPA 1996 report, defines most of the older data. The newer system devised by the World Health Organisation (WHO) in 1998 also incorporates PCBs. The WHO have also suggested that the TEQ scheme be re-evaluated every five years and that TEFs be reanalysed in the light of any new scientific information. Clearly it is important when comparing data to define correctly the TEQ units and also whether PCBs are being considered. Usually I-TEQ concentrations will be a little lower than WHO-TEQs as some of TEFs have been revised upwards by the WHO. The TEF values for both systems are tabulated in Annex 1. In general, it can be safely assumed that older data will have been calculated according to the I-TEQ system.

Treatment of Levels Below Detection Limits

In calculating TEQs for compounds that are not found in concentrations above the limit of detection, the conventional approach up to relatively recently was to use one half of the detection level for non-detects (congeners not found at the analytical detection level). A recent EC Directive which set maximum levels for dioxins in foodstuffs stipulated that limits of quantification (LOQs) [1] be used instead of limits of detection (LODs)[2] and also that the full LOQ should be taken in the calculation of non-detects (EC 2001). This is a totally conservative approach to estimating TEQs at trace levels, and it can lead to an over-estimation of concentrations in low level samples. This method, which was generally introduced in 2002, has been used in the calculations below and should be borne in mind when making comparisons with older low level studies. As not all reported data consider non-detects, it is important to clarify this issue when comparing low level data from different sources.

[1]Limit of quantification is commonly defined as:

> *The limit of quantification is the smallest concentration of unknown that can reliably be **quantified** by the instrumental method. The accepted limit is that concentration of analyte, which produces an instrumental response that is ten times as large as the standard deviation S of the instrumental noise level (L.O.Q. = 10 x S/N)*

[2]Limit of detection as used in analytical chemistry is commonly defined as:

> *The limit of detection is the smallest concentration of unknown that can reliably be **detected** by the instrumental method. The accepted limit is that concentration of analyte, which produces an instrumental response that is three times as large as the standard deviation S of the instrumental noise level (L.O.D. = 3 x S/N)*

2. NATIONAL DIOXIN SURVEY

Background

This survey was planned as a follow-up to the national surveys carried out in 1995, 2000, 2004 2006 and 2007. As far as possible, the same approach was adopted in terms of time of year and location of samples. However, unlike the 1995 survey, the analyses included the 12 dioxin-like PCBs.

Samples were taken in June and July 2008 when the cows could be expected to be grazing outdoors. Details are given in Tables 1 and 2.

Sampling strategy

Two types of sampling stations were chosen:

Type A background stations covering the entire country (24 samples)
Type B potential impact stations in areas of perceived potential risk (13 samples)

Type A samples were normally taken from full milk silos (30,000 to 50,000 gallons) in regional dairies. However there were a number of instances where sampling from silos was not possible and the samples were taken instead from road tankers representative of the area to be covered. Type B samples were taken from road tankers representing the "potential impact" areas.

Sampling procedure

Samples were taken in thick-walled pyrex glass bottles of one litre capacity, which had been washed with detergent and acetone. The sample volume was 800 ml. Duplicate samples were taken with the intention of submitting one sample for analysis and retaining the other sample in the EPA regional laboratories in the event of a sample being lost in transport or a repeat analysis being required.

The samples were taken by EPA personnel while the milk was still in its raw state. The samples were then taken to the nearest EPA regional laboratory where they were frozen at –20° C. Shipment of samples was by overnight courier in ice boxes to the laboratory (see below).

Analysis

The laboratory chosen for the analyses was the same one used for previous surveys, Gesellschaft für Arbeitsplatz und Umweltanalytik (GfA) laboratory in Münster, Germany. This laboratory is very experienced in the analysis of dioxins in milk and other food matrices and has undertaken analyses for clients in many countries. The laboratory is fully accredited for the analysis of PCDDs, PCDFs and PCBs in food matrices, including milk.

Analyses were carried out following pre-treatment and extraction from the milk fat, using high resolution gas chromatography and high resolution mass spectrometry with ^{13}C-labelled isomers as internal standards. This method is considered to be the most suitable for low-level dioxin measurements. The analytical methodology is in compliance with the requirement for the analysis of foodstuffs for PCDD/Fs and PCBs as laid down by the EU directive 2002/69 and its amendment 2004/44.

Results and Tables

The data showing I-TEQs and WHO-TEQs for milk fat are shown in Tables 1 and 2 with a statistical summary in Table 3.

Data for whole milk are also available and are shown in Annex 2 as fresh-weight data for individual congeners. However, for comparison purposes it is generally more useful to use the milk fat rather than whole milk data due to the varying composition of fat in milk. Using the fat data also facilitates comparisons with other dairy products such as butter and cheese and also with human milk. Regulatory limits are also generally expressed in terms of dioxin content in fat.

The detailed analytical results showing the levels for the individual congeners are also given in Annex 2.

The fat content was measured separately and TEQs were determined in fat and then back-calculated to give corresponding levels in the original whole milk sample. (Annex 2)

Table 1

Milk fat related PCDD/F and PCB-TEQ values determined in the background samples A 1 - A 25

Sample	Milk supply area	Dioxins		PCBs	Dioxins & PCBs
		I-TEQ incl. LOQ	WHO-TEQ incl. LOQ	WHO-TEQ incl. LOQ	Total WHO-TEQ incl. LOQ
	Unit	*pg/g milk fat*	*pg/g milk fat*	*pg/g milk fat*	*pg/g milk fat*
A1	Mitchelstown Area (T)	0.229	0.280	0.154	0.434
A2	Co. Waterford (T)	0.215	0.244	0.161	0.405
A3	Dublin South.Co./North Wicklow Area (T)	0.293	0.330	0.237	0.567
A4	North Co. Wexford (T)	0.262	0.300	0.207	0.507
A5	Charleville, Co Cork Area (T)	0.177	0.198	0.106	0.304
A6	Ballyragget, Co Kilkenny Area (T)	0.212	0.236	0.164	0.400
A7	Renmore, Co Galway Area	0.178	0.201	0.135	0.336
A8	Moate, Co Westmeath Area	0.201	0.223	0.169	0.392
A9	Tipperary Town/Thurles Areas	0.197	0.222	0.157	0.379
A10	Nenagh, Co. Tipperary Area	0.196	0.213	0.141	0.354
A11	Cavan/Longford/Leitrim	0.203	0.227	0.154	0.381
A12	Drinagh, Co Cork (T)	0.203	0.225	0.178	0.403
A13	Bandon Area (T)	0.213	0.239	0.174	0.413
A14	North Kerry Area (T)	0.17	0.19	0.128	0.318
A15	Co Sligo	0.184	0.202	0.153	0.355
A16	Roscommon/East Galway	0.213	0.238	0.167	0.405
A18	Roscommon/Leitrim	0.204	0.228	0.196	0.424
A19	Co Monaghan (T)	0.260	0.300	0.239	0.539
A20	Co Louth	0.232	0.264	0.200	0.464
A21	North Kildare/West Dublin (T)	0.197	0.224	0.127	0.351
A22	So Kerry Cahirciveen area) (T)	0.251	0.346	0.106	0.452
A23	South Wexford	0.227	0.259	0.150	0.409
A24	SE Co. Mayo	0.175	0.197	0.150	0.347
A25	Co. Donegal	0.237	0.227	0.108	0.385

Sample corresponding to A17 was taken only in the 1995 survey
(T) Denotes sampling from a road tanker. All other "**A**" samples were taken from bulk silos.

Table 2

Milk fat related PCDD/F and PCB-TEQ values determined in the potential impact samples B1 - B 17

Sample No.	Milk supply area	Dioxins		PCBs	Dioxins and PCBs
		I-TEQ incl. LOQ	WHO-TEQ incl. LOQ	WHO-TEQ incl. LOQ	Total WHO-TEQ incl. LOQ
	Unit	*pg/g milk fat*	*pg/g milk fat*	*pg/g milk fat*	*pg/g milk fat*
B1	Carrigtwohill/ Cobh/Great Island	0.282	0.325	0.161	0.486
B2	Ahgada/East Cork Harbour	0.182	0.204	0.135	0.339
B3	Askeaton area	0.421	0.673	0.162	0.835
B4	Tarbert Co. Kerry	0.373	0.588	0.119	0.707
B5	Clarecastle Co.Clare	0.174	0.196	0.111	0.307
B6	Cooraclare Co.Clare	0.183	0.202	0.136	0.338
B7	Ballydine, So. Tipperary	0.219	0.248	0.143	0.391
B8	Swords/ Mulhuddart. Co.Dublin	0.279	0.318	0.355	0.673
B9	Grannagh. So.Kilkenny	0.210	0.230	0.170	0.400
B13	Kinsale (Dunderow) Co.Cork	0.234	0.251	0.186	0.437
B14	Ringaskiddy area. Co.Cork	0.238	0.269	0.152	0.421
B15	Crossakiel (nr Kells). Co.Meath	0.223	0.249	0.222	0.471
B17	Carranstown Co.Meath	0.332	0.370	0.388	0.758

Samples corresponding to B10, B11 and B12 in the 1995 survey were not taken in 2000, 2004, 2006, 2007 or 2008.

.

Sample corresponding to B16 in the 2000 survey was not taken in 1995, 2004, 2006, 2007 or 2008.

All "**B**" samples were taken from road tankers.

Table 3
Summary of Milk Fat Data in pg TEQ/g fat

	"A" Samples				***"B" Samples***				***"A and "B" Samples combined***			
Parameter	**Dioxins**		**PCBs**	**Dioxins & PCBs**	**Dioxins**		**PCBs**	**Dioxins & PCBs**	**Dioxins**		**PCBs**	**Dioxins & PCBs**
	I-TEQ	*WHO-TEQ*	*WHO-TEQ*	*WHO-TEQ*	*I-TEQ*	*WHO-TEQ*	*WHO-TEQ*	*WHO-TEQ*	*I-TEQ*	*WHO-TEQ*	*WHO-TEQ*	*WHO-TEQ*
Minimum	0.170	0.190	0.106	0.304	0.174	0.196	0.111	0.307	0.170	0.190	0.106	0.304
Maximum	0.293	0.346	0.239	0.567	0.421	0.673	0.388	0.835	0.421	0.673	0.388	0.835
Mean	0.214	0.242	0.161	0.405	0.258	0.317	0.188	0.505	0.229	0.269	0.170	0.440
Median	0.208	0.228	0.156	0.402	0.234	0.251	0.161	0.437	0.213	0.238	0.157	0.157
Samples	24	24	24	24	13	13	13	13	37	37	37	37
EU Limit		**3.0**		**6.0**		**3.0**		**6.0**		**3.0**		**6.0**
EU Action level		**2.0**	**2.0**			**2.0**	**2.0**			**2.0**	**2.0**	

Discussion

Summary
Considering the entire set of samples (Tables 1 and 2), the reported I-TEQ ranges for dioxins in milk fat are 0.170 to 0.421 pg I-TEQ/g and 0.190 to 0.673 pg WHO-TEQ/g with overall mean values of 0.229 pg I-TEQ/g and 0.269 WHO-TEQ/g. Including PCBs, the range is 0.304 to 0.835 pg WHO-TEQ with a mean of 0.440 WHO-TEQ/g.

Dioxins
A summary of the milk fat data showing a breakdown of the background (type A), and the potential impact (type B) samples along with the combined data set is presented in Table 3. All of the results are well below the EU dioxin limit of 3.0 pg WHO-TEQ/g. They range from 0.190 WHO-TEQ/g to 0.673 pg WHO-TEQ/g. While samples B3 (Askeaton area) and B4 (Tarbert area) are higher than other samples reported in the 2008 survey, it is important to note that they are low compared to both the EU limit and EU action value Figure 1). Furthermore, preliminary results form the 2009 survey show dioxin levels in these areas at about one third of the 2008 levels. See also Section 3 for a comparison with earlier surveys.

PCBs
The highest dioxin-like PCB level was the B8 sample at 0.388 WHO-TEQ/g, less than 20% of the action level. The mean value was 0.170 pg WHO-TEQ/g with a range of 0.106 to 0.388 pg WHO-TEQ/g. There is no separate EU limit value for dioxin-like PCBs.

Dioxins & PCBs
The B3 sample gave highest value of 0.835
pg WHO-TEQ/g for the sum of Dioxins & PCBs combined, 14% of the EU limit for this parameter.

Pork Feed Contamination Incident

All samples for this survey were taken by July 2008 whereas the pork-feed contamination incident referred to in Section 1 was estimated to have occurred in the period September-November 2008.

Nevertheless it was decided to examine the results for relevance to the pork feed contamination incident. The contamination was allegedly caused by combustion gases coming into direct contact with the feed material and where an inappropriate fuel containing PCB waste was used.

Formation and dispersion of certain PCDF (dibenzofuran) isomers in a single step can be a consequence of low temperature burning of PCBs. On the other hand, the formation of PCDDs would involve the severing the carbon bond between two phenyl rings and is not considered a likely outcome. (Erikson1997). This means that predominance of certain PCDF isomers, in this case, 2,3,4,7,8 PCDF or 2,3,7,8 PCDF which can be formed from the common PCBs 138 and 153 respectively, would be possibly indicative of burning of PCBs. No evidence of predominance of these specific isomers over other PCDF or PCDD isomers was found in any of the milk survey samples.

It seems reasonable to conclude therefore that the results of the 2008 survey were unaffected by the above incident.

(The preliminary results from the 2009 survey show levels in the area that are in the national 'average' range for both PCB and dioxins.)

Figure 1 Dioxins/Furans
2008 Data

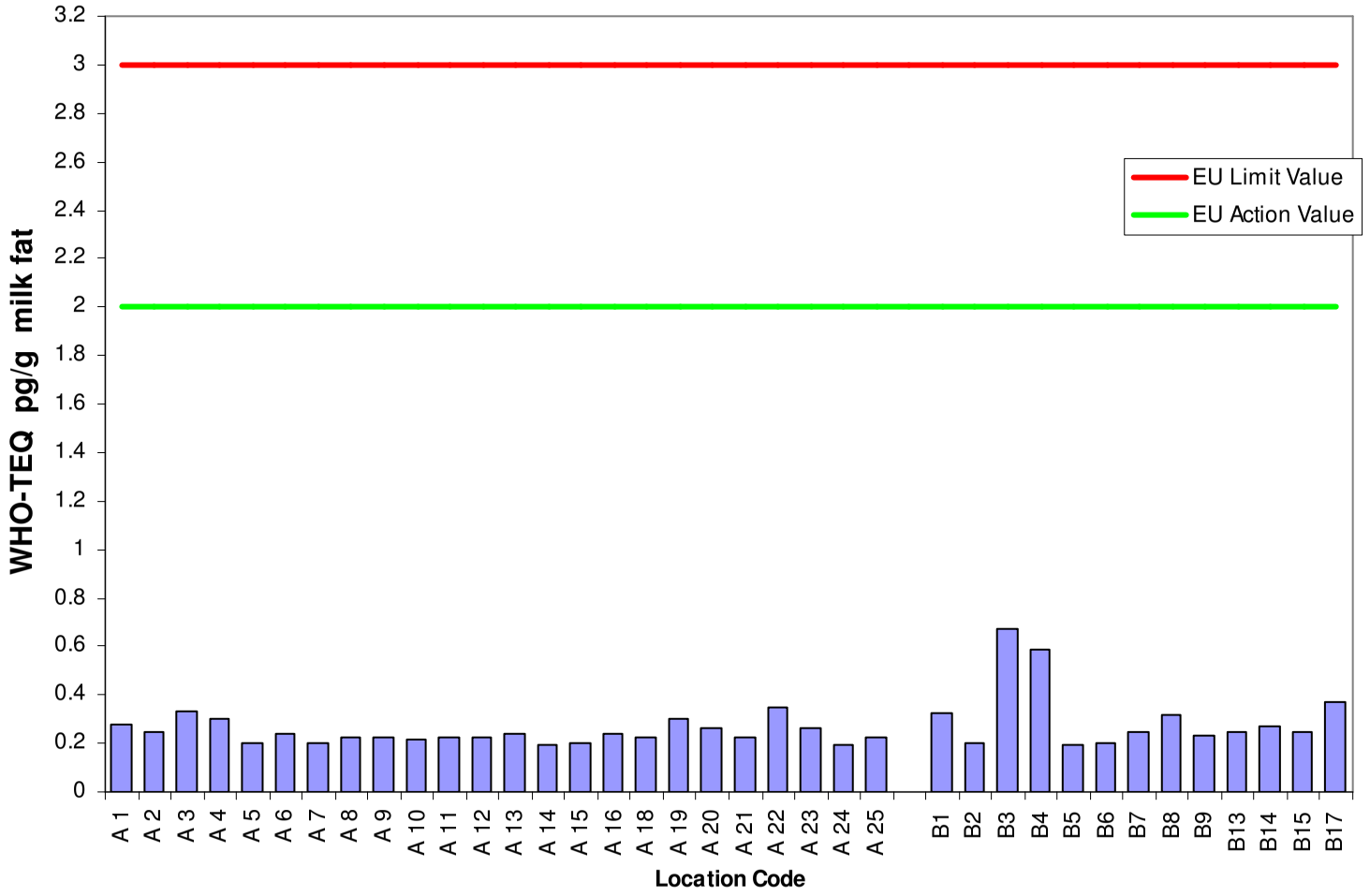


Figure 2 Dioxin-like PCBs
2008 Data

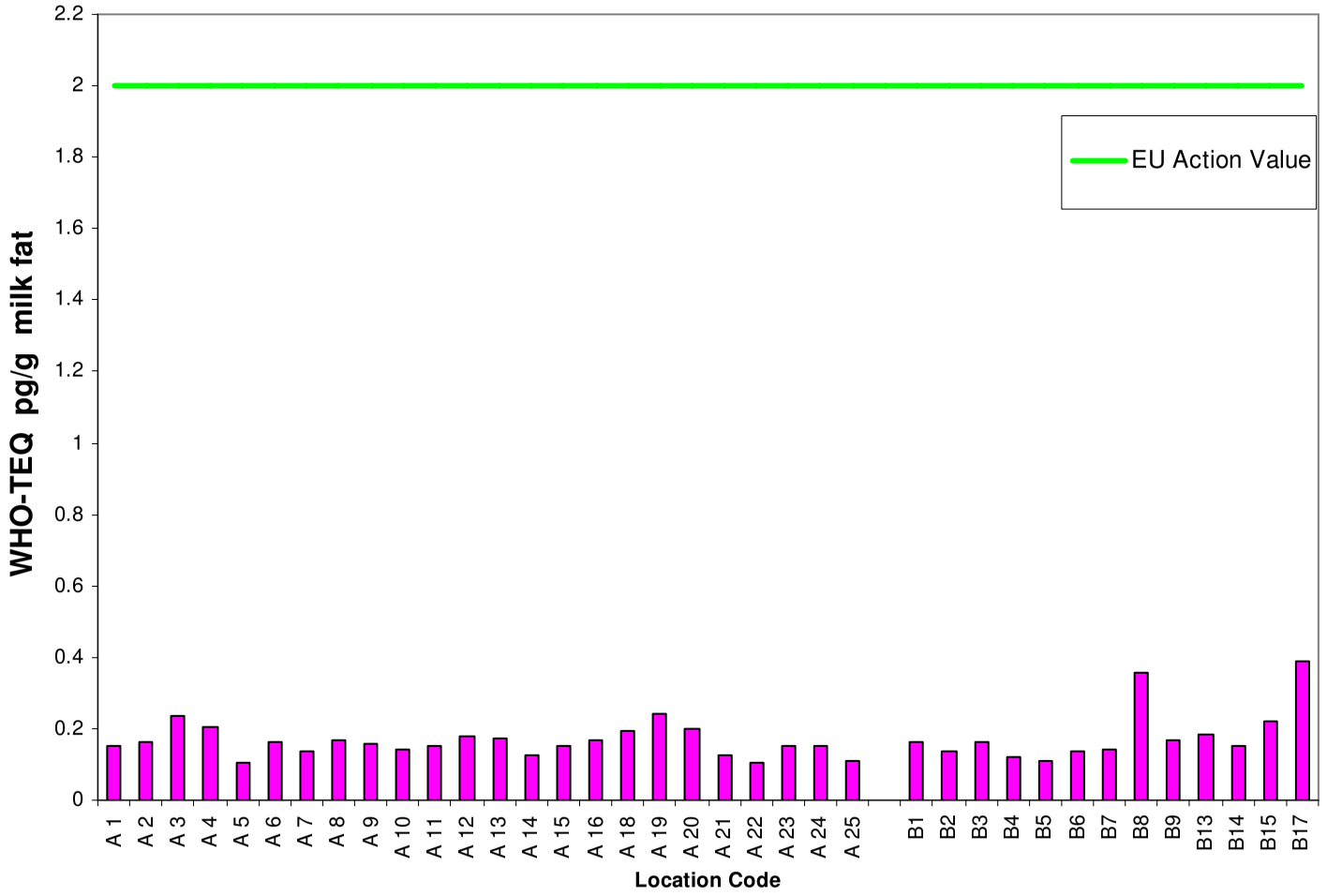


Figure 3 Dioxins+ PCBs
2008 Data

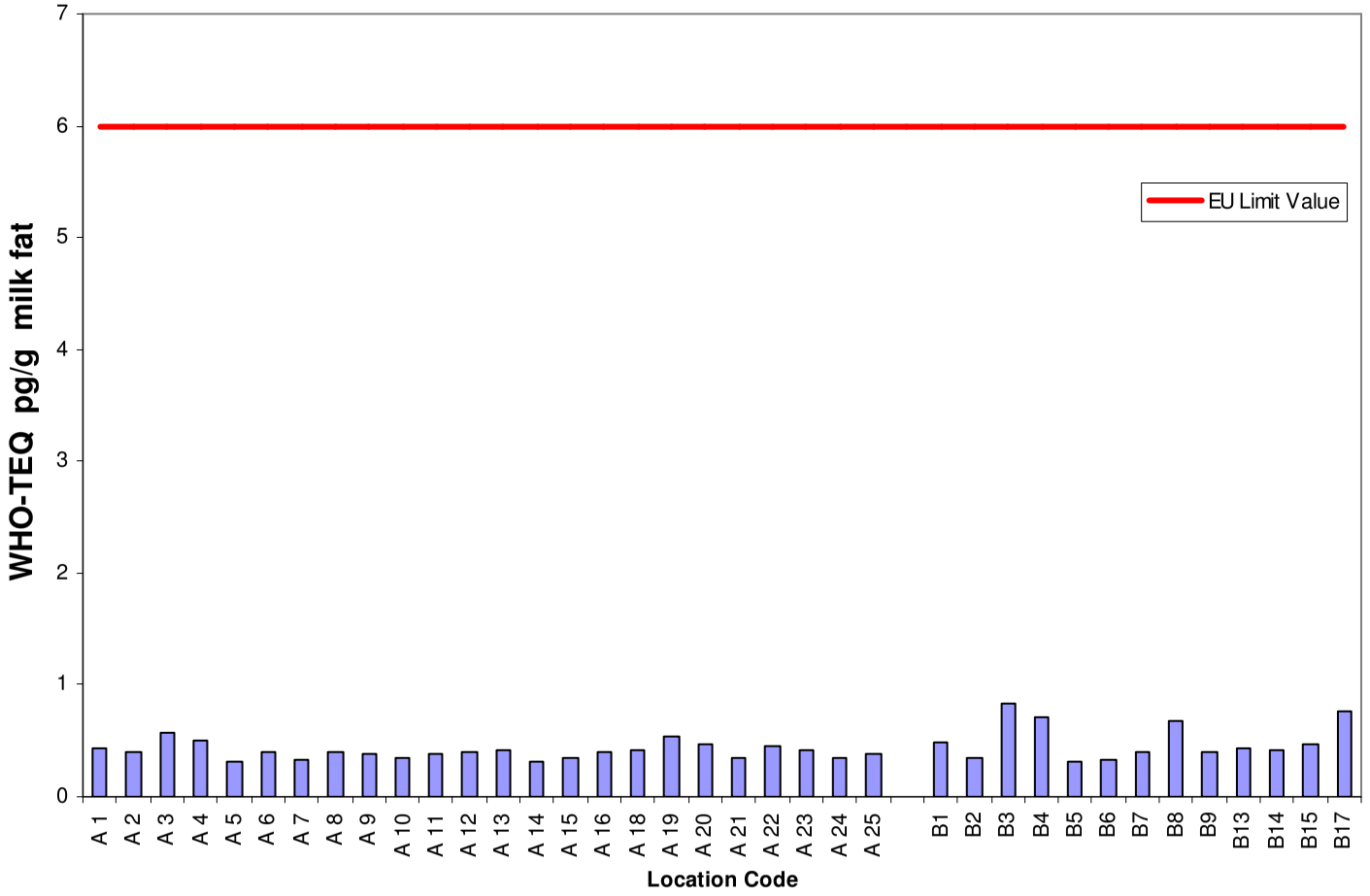


Figure 4
Comparison of 2000, 2004, 2006, 2007, 2008 surveys
A Samples PCDD/F

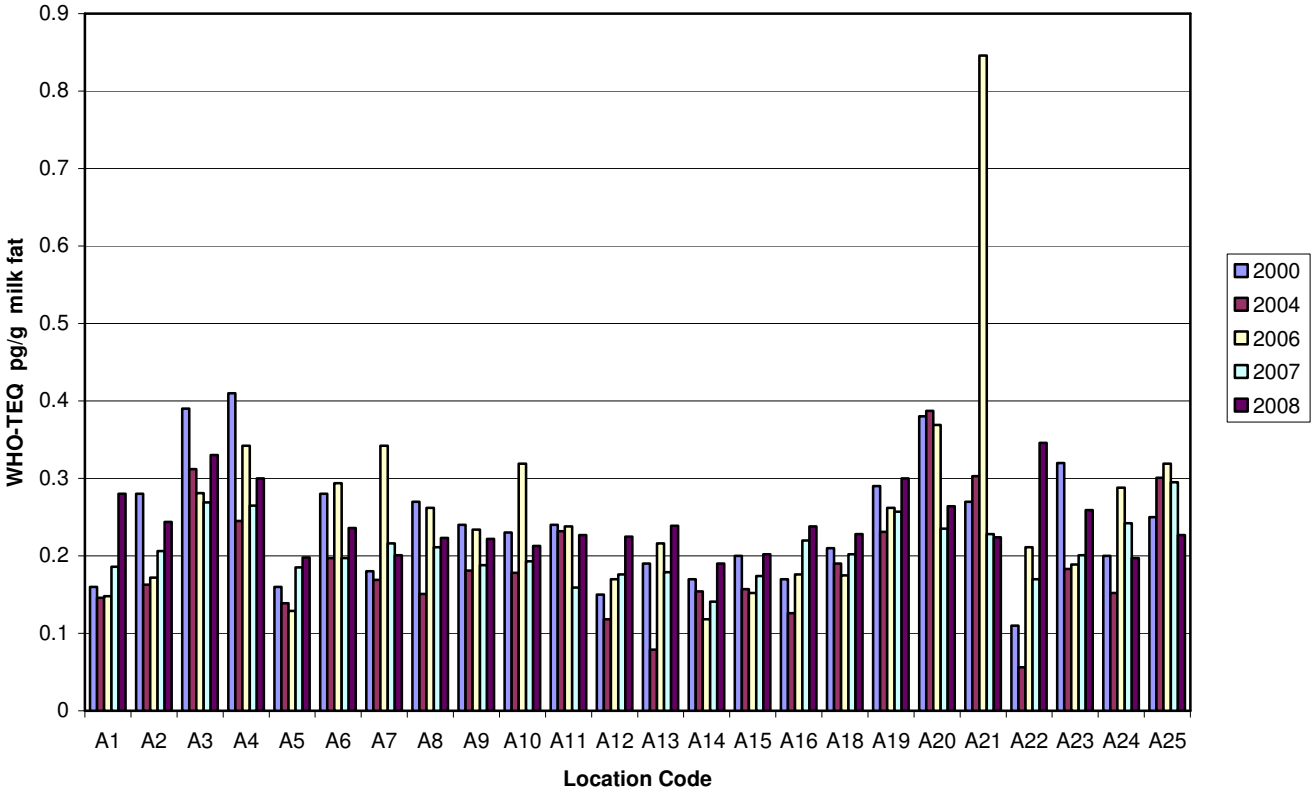


Figure 5
Comparison of 2000, 2004, 2006, 2007, 2008 surveys PCDD/F
B Samples

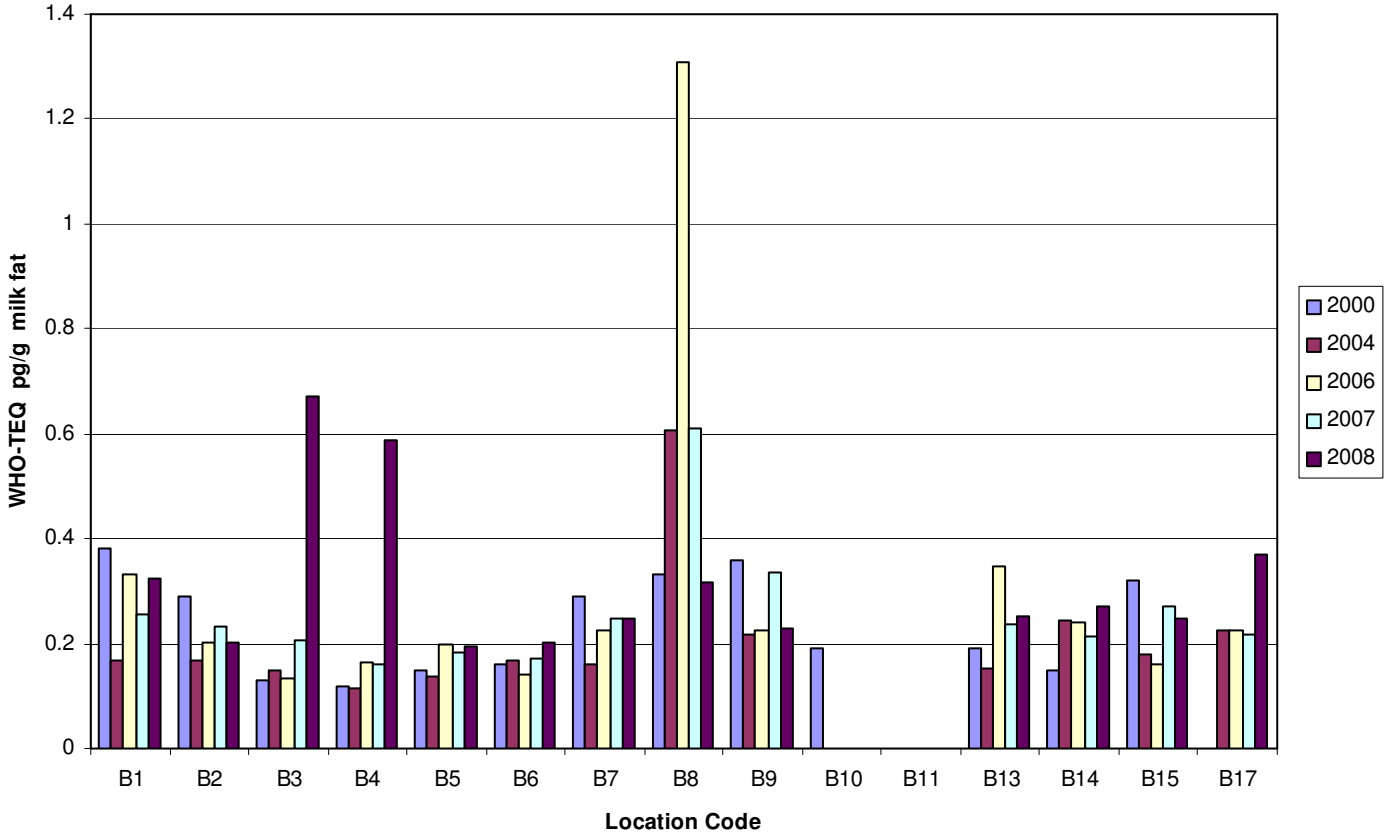


Figure 6 Comparison of 1995, 2000, 2004, 2007 & 2008 surveys for PCBs
A Samples

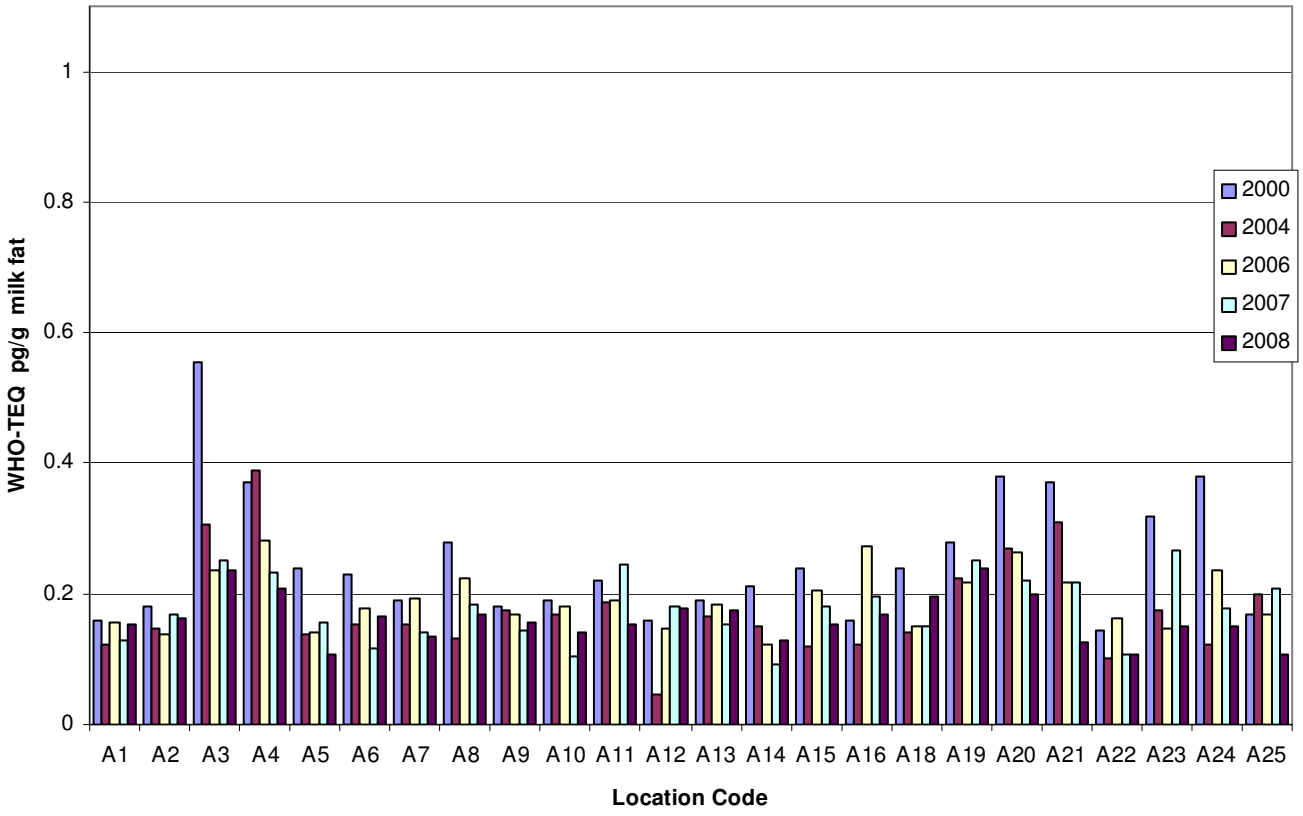
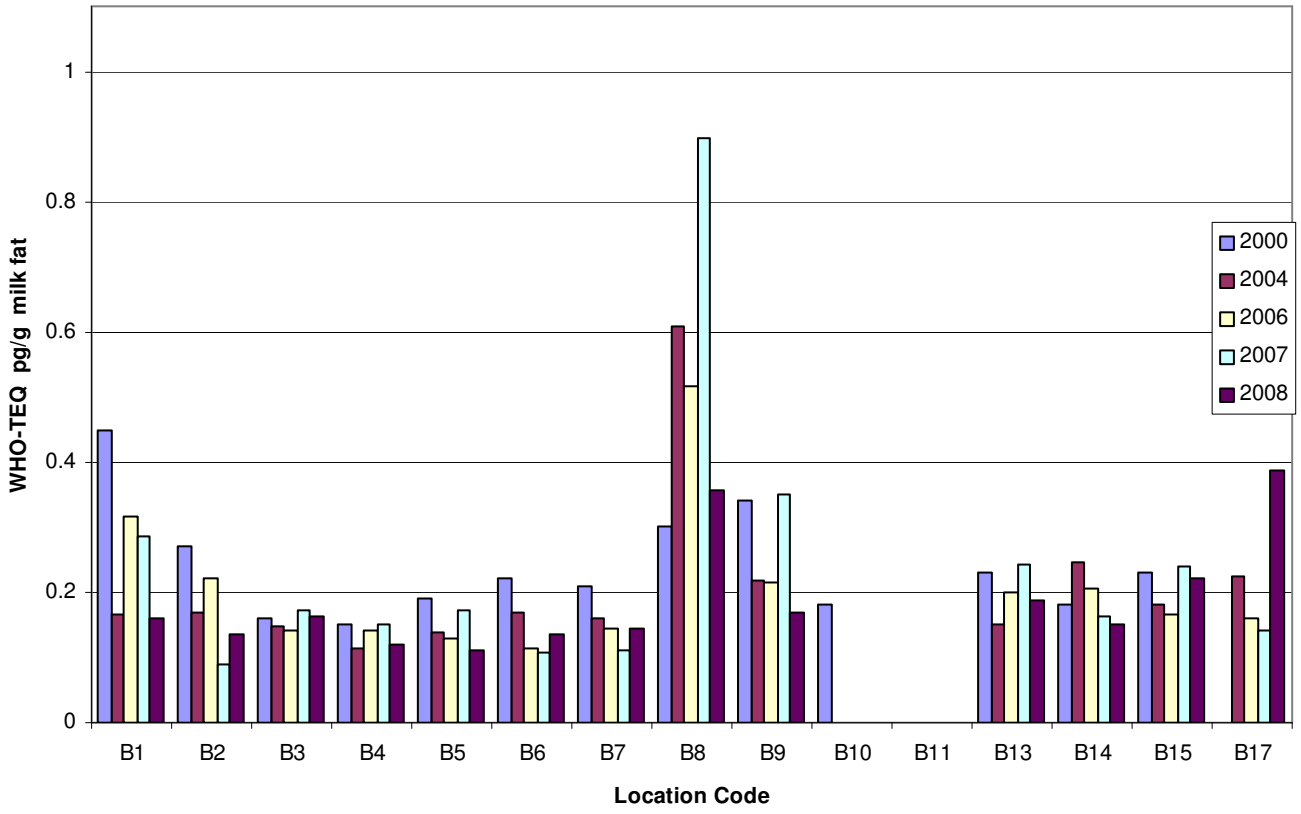


Figure 7 Comparison of 2000, 2004, 2006, 2007 & 2008 Surveys for PCBs.
B Samples



3. COMPARISON WITH EARLIER DIOXIN SURVEYS

Figures 4 and 5 show a comparison of the dioxin WHO-TEQ milk fat data with the four most recent surveys. As for the 2007 survey, comparisons are now made with WHO-TEQ data unlike earlier reports, where they were made using the older I-TEQ data. Figures 6 and 7 show the equivalent comparison of the PCB WHO-TEQ milk fat data.

These may be read in conjunction with Table 4, which shows the average WHO-TEQ for both dioxins and PCBs at each station for the four surveys. As previously mentioned, comparisons of low-level data over time should be made with a certain amount of caution. For example, analytical sensitivity has improved and the treatment of amounts reported below the limits of detection has changed (EPA 2005).

In addition, the amalgamation and re-organisation of certain dairies following the rationalisation of the dairy industry can make historical comparisons of individual sample points somewhat problematic. These issues are discussed more fully in earlier reports (EPA 2005).

The mean value for dioxins in milk fat in the 2008 survey was 0.269 pg WHO-TEQ/g compared to corresponding mean values of 0.225, 0.275, 0.195 and 0.24 pg WHO-TEQ/g for the 2007, 2006, 2004 and 2000 surveys, respectively. It can be seen that the 2008 results are broadly in line with the earlier similar EPA surveys.

In the case of PCBs the 2007 mean value of 0.170 pg WHO-TEQ/g was marginally lower than the 2007, 2006 and 2004 mean values 0.200, 0.196 and 0.187 pg WHO-TEQ/kg respectively.

It can be seen from Table 4 that, in terms of the averages for the A samples over the period 2000 to 2008, locations having average dioxin concentrations of less than 0.2 pg WHO-TEQ/g were typically in west Munster and north Connaught, whereas those with concentrations greater than 0.3 pg WHO-TEQ/g were typically along the east coast. A broadly similar pattern may be observed with respect to PCB concentrations. This is likely to reflect the broad pattern of an increase in anthropogenic influences from west to east.

In terms of the highest dioxin and PCB results from the survey it should be noted that the highest levels from each of the three most recent surveys (2004, 2006 and 2007) was from the B8 sample, a large single farm in the North Dublin suburbs. This farm has been destocked so an alternative composite sample from several farms in a slightly more rural area of North County Dublin was taken. This may explain the reduced dioxin concentrations from the B8 sample for 2008 although it still had the highest PCB value for the survey, although lower than earlier years. The highest dioxin levels recorded in the 2008 survey were just about half of the overall peak levels that occurred (in 2006) in North Dublin.

Table 4

Mean Dioxin and PCB Values for the Period 2000-2008

WHO-TEQ pg/g milk fat

Showing locations where two or more samples were taken over the period

A Samples

Sample	Milk supply area	PCDD/F	PCBs
A1	Mitchelstown Area	0.18	0.14
A2	Co. Waterford	0.21	0.16
A3	Dublin So.Co./ N. Wicklow Area	0.32	0.32
A4	North Co. Wexford	0.31	0.30
A5	Charleville, Co. Cork Area	0.16	0.16
A6	Ballyragget, Co. Kilkenny Area	0.24	0.17
A7	Renmore, Co. Galway Area	0.22	0.16
A8	Moate, Co. Westmeath Area	0.22	0.20
A9	Tipperary Town/ Thurles Areas	0.21	0.17
A10	Nenagh, Co. Tipperary Area	0.23	0.16
A11	Cavan/Longford/ Leitrim	0.22	0.20
A12	Drinagh, Co. Cork	0.17	0.14
A13	Bandon Area	0.18	0.17
A14	North Kerry Area	0.15	0.14
A15	Co. Sligo	0.18	0.18
A16	Roscommon/East Galway	0.19	0.18
A18	Roscommon/Leitrim	0.20	0.18
A19	Co. Monaghan	0.27	0.24
A20	Co. Louth	0.33	0.27
A21	N. Kildare/ W. Dublin	0.37	0.25
A22	So. Kerry Cahirciveen area	0.18	0.12
A23	South Wexford	0.23	0.21
A24	SE Co. Mayo	0.22	0.21
A25	Co. Donegal	0.28	0.17

B Samples

Sample	Milk supply area	PCDD/F	PCBs
B1	Carrigtwohill/Cobh/ Great Island	0.29	0.28
B2	Ahgada/East Cork Harbour	0.22	0.18
B3	Askeaton area	0.26	0.16
B4	Tarbert Co. Kerry	0.23	0.14
B5	Clarecastle Co. Clare	0.17	0.15
B6	Cooraclare Co. Clare	0.17	0.15
B7	Ballydine, So. Tipperary	0.23	0.15
B8	Castleknock/Mulhuddart. Co. Dublin	0.60	0.54
B9	Grannagh, So. Kilkenny	0.28	0.26
B13	Kinsale (Dunderow) Co. Cork	0.24	0.20
B14	Ringaskiddy area. Co. Cork	0.23	0.19
B15	Crossakiel (nr Kells), Co. Meath	0.24	0.21
B17	Carranstown, Co. Meath	0.27	0.23

4. OTHER STUDIES IN MILK AND DAIRY PRODUCTS

Data submitted to the EU Commission on 152 dairy samples (milk and milk products) between 1997 and 2003 from the then 15 member states plus Iceland and Norway as part of an EU-wide survey showed an overall mean of 0.77 pg WHO-TEQ/g fat (Gallani et al, 2004). No upper or lower limits are shown in the study.

Dairy samples analysed by GfA between 2003 and 2005 on behalf of mainly Western European clients showed an overall mean of 0.35 pg WHO-TEQ/g fat for dioxins with a range of 0.11 to 1.33 WHO-TEQ/g. (Hamm et al, 2005, n =138).

Data from a German monitoring programme of dairy product samples from North-Rhine Westphalia gave an overall mean for dioxins of 0.52 pg WHO-TEQ/g fat and 0.92 pg WHO-TEQ/g fat dioxin-like PCBs. The ranges were 0.30 to 0. 97 WHO-TEQ/g fat and 0.34 to 1.42 WHO-TEQ/g fat for dioxins and dioxin-like PCBs respectively. (Fuerst 2006)

A US EPA study of samples taken from eight different regions in the US in July 2000 and January 2001 showed an overall composite mean of 0.71 pg WHO-TEQ/g fat. Again no upper or lower limits are shown in the study. (Schuda et al 2004)

Samples taken on behalf of the UK Food standards Agency in 2005 showed a mean of 0.37 pg WHO-TEQ/g and a range 0 32 to 0.48 pg WHO-TEQ/g A similar 2006 study showed a mean of 0.34 pg WHO-TEQ/g with a range of 0.19 to 0.52 pg WHO-TEQ/g (FSA 2005, FSA 2006, n=4 in each case).

A French national survey carried out in April 2006 of 239 raw cow's milk samples from 93 plants showed average concentrations of 0.33 pg PCDD/Fs and 0.57 pg dioxin-like PCBs in raw cows' milk. (Durand et al 2008)

These comparisons are summarised in Table 5.

It is clear, therefore, that the levels of dioxins in the Irish studies are low by international comparisons.

Dioxin Limits in Milk

The EU limit for dioxins and furans for milk and milk products is set at 3.0 pg WHO-TEQ/g fat. When PCBs are included it is 6.0 pg WHO-TEQ/g fat (EC 2006 (1)).

The EU action level for dioxins and furans is 2.0 pg WHO-TEQ/g fat. The action level for PCBs is also set at 2.0 pg WHO-TEQ/g fat. There is no separate limit for PCBs, (EC 2006 (2)). It is clear that the overall mean levels found in all of the Irish surveys are at least an order of magnitude below the above limits.

Table 5:

Comparison of dioxin and PCB WHO-TEQ values from Irish cows' milk samples with data from international monitoring programs

Country	**Period of sampling**	**Number and specification of samples**	**Dioxins/Furans Mean values pg WHO-TEQ/g fat**	**PCBs Mean values pg WHO-TEQ/g fat**	**Dioxin/Furans plus PCB Mean values pg WHO-TEQ/g fat**
Ireland	2000	24 A-samples 13 B-samples	0.24 0.24	0.25 0.24	0.49 0.48
Ireland	2004	24 A-samples 13 B-samples	0.19 0.21	0.18 0.21	0.37 0.41
Ireland	2006	24 A-samples 13 B-samples	0.26 0.30	0.19 0.21	0.45 0.51
Ireland	2007	24 A-samples 13 B-samples	0.21 0.26	0.18 0.24	0.39 0.50
Ireland	2008	24 A-samples 13 B-samples	0.24 0.32	0.16 0.19	0.41 0.51
UK	2005	4 samples	0.37	0.22	0.59
UK	2006	4 samples	0.34	0.18	0.52
US	2000-2001	16 samples	0.71	Not reported	Not reported
Germany	2006	68 samples	0.52	0.92	1.44
France	2006	237 samples	0.33	0.57	0.90
Western Europe	2003-2005	138 Milk and milk products from Western European countries	0.39	0.62	0.98
European Union	1997 - 2003	152 Milk and milk products from EC monitoring programmes	0.77	1.65	2.42

5. BROMINATED FLAME RETARDANTS AND BROMINATED DIOXINS

General

Brominated Flame Retardants (BFRs) replaced PCB as the major chemical flame retardant in the late 1970s and are commonly used in furniture, fabrics and electronic products as a means of reducing the flammability of combustible organic materials. They act as radical traps, i.e. in case of fire the pyrolysis products are retarded in their reaction with atmospheric oxygen by reaction with the halogen radicals released from the BFR. The benefit of these chemicals is their ability to slow ignition and rate of fire growth, and as a result increase available escape time in the event of a fire.

Brominated dioxins and furans (PBDD/PBDF) can be formed as a by-product of the combustion of these substances

.

Different types of Brominated Flame Retardants

TBBPA tetrabromo bisphenol A

PBBs: Polybrominated biphenyls (structurally similar to PCBs)

HBCD: Hexabromocyclododecane

PBDEs: Polybrominated diphenyl ethers
- Deca-BDE (Decabromodiphenyl ether or BDE-209)
- Octa-BDE (Octabromodiphenyl ether)
- Penta-BDE (Pentabromodiphenyl ether)

TBBPA, the PBDEs and the PBBs contain two brominated carbon rings, making them very stable and efficient in a large number of plastics. PBBs and PBDE are of greatest environmental interest because they are considered as persistent and bioaccumulative. PentaBDE is considered as very poisonous to water organisms. PBDEs are classified as priority substances according to the EU Water Framework Directive. EU has banned the use of Penta-and OctaBDE since 2004. BDE-47 and BDE-99 are the predominant congeners in environmental samples (FSAI 2005). However, only few estimates of human dietary PBDE exposure are available and little is known about other forms of human exposure (e.g. inhalation, skin contact).

PBBs are also banned.

Brominated dioxins and furans (PBDD/PBDF)

These substances are formed unintentionally, either through, incineration of wastes that include consumer products containing brominated flame retardants like PBDEs, accidental fires or as trace contaminants in mixtures of bromine-containing chemicals.

Results of Study.

Five pooled samples were analysed for the above range of BFRs and PBDD/PBDFs. Seventeen PBDE congeners (BDE-17, 28, 47, 49, 66, 71, 77, 85, 99, 100, 119, 126, 138, 153, 154, 183 and 209), some individual PBBs (BB-52, 101, 153 and 209), the totals of Tetra to NonaBBs, hexabromocyclododecane (sum of a-, b- and g-HBCD) and tetrabrombisphenol A (TBBP-A) have been monitored in this study.

Only PBDEs were detected in this study.
The data are summarised in Table 6.

PBDEs
The range for Σ–PBDEs (N=5) was 57 to 144 ng/kg fat with a mean of 93 ng/kg fat. (Table 6) This compares with the mean value of 152 ng/kg fat from 2007 and 200 ng/kg fat from 2006 (EPA 2008, Grümping & Petersen 2007) and also contrasts favourably with the 2005 FSAI study carried out in the same laboratory where the average concentration for Σ–PBDE was 407 ng/kg fat (N=12) FSAI (2006).
Although there are no maximum limits set for PBDEs, these levels are relatively low by international comparisons.

As in the earlier surveys, the main contributors (c. 80%) to the total PBDE load were BDE-47 and BDE-99, with smaller contributions from BDE-100 and BDE-153. No other PBDE isomers were found. This is consistent with expectations (see above).

Brominated Dioxins PBDD/PBDFs
No PBDD/PBDF congeners were detected in 2008. This is in line with the 2007 data and unlike the apparently anomalous data found 2006 where a value as high as 1.67 pg WHO-TEQ/g was found,.
The WHO-TEQs for PBDD/PBDF listed in Table 6 can therefore be simply described as Maximum Values reflecting the detection levels of the individual congeners.

Table 6

Summary of Milk Fat Data for PBDEs and PBDD/F

	Sample 1	***Sample 2***	***Sample 3***	***Sample 4***	***Sample 5***	***Mean***
	Cork Hbr pg/g fat	***Midlands pg/g fat***	***West pg/g fat***	***East pg/g fat***	***N/NW pg/g fat***	***pg/fat***
Pooled from samples	B1 B2 B14	A5 A8 A9	A17 A15 A24	A3 A20 A23	A11 A19 A25	
PBDEs	***144***	***78***	***57***	***63***	***124***	***93***
PBDD/F *(WHO-TEQ **)***	***0.49***	***0.19***	***0.58***	***0.25***	***0.31***	***0.36***

6. CONCLUSIONS

1. All levels recorded in this survey compare favourably with those taken from a random selection of similar studies in other EU countries. While assessment of consumer exposure to dioxins through the consumption of milk was not the object of this environmental survey, the highest levels were well below legislative limits.

2. The results are broadly in line with earlier EPA surveys.

3. The Brominated Flame Retardants (BFR) and Brominated Dioxin survey showed similarly low levels to the 2007 EPA survey. The levels were lower than those from the 2006 EPA survey and the 2005 FSAI survey. This however demonstrates the difficulty of over-interpretation of apparently random fluctuations in results from environmental surveys where the levels are very low or approaching limits of detection.

4. There was no evidence to link the data from the survey to the Pork feed contamination incident in late 2008.

References

1. EPA 1996. Dioxins in the Irish Environment, An Assessment Based on Levels in Cows' Milk. EPA, Wexford.
2. EPA 2001. Dioxin Levels in the Irish Environment, Second Assessment Based on Levels in Cows' Milk. EPA, Wexford.
3 EPA 2005. Dioxin Levels in the Irish Environment, Third Assessment Based on Levels in Cows' Milk. EPA, Wexford.
4. EPA 2005b. The Nature and Extent of Unauthorised Waste Activity in Ireland. EPA, Wexford.
5. EPA 2008 (1). Dioxin Levels in the Irish Environment, Fourth Assessment Based on Levels in Cows' Milk. EPA, Wexford.
6. EPA 2008 (2). Dioxin Levels in the Irish Environment, Fifth Assessment Based on Levels in Cows' Milk. EPA, Wexford.
7. Dyke and Coleman, 1997. Dyke, P., Coleman, P., James, R.,. Dioxins in Ambient Air, Bonfire Night 1994. Chemosphere Vol. 34, 1191-1201.
8. Gullett et al. PCDD/F Emissions from Uncontrolled Domestic Waste Burning, Organohalogen Compounds 46, 193-196.
9. Hayes & Marnane 2002. Inventory of Dioxin and Furan Emissions to Land, Air and Wastes. EPA, Wexford.
10. DOEHLG 2009. Waste Management (Prohibition Of Waste Disposal By Burning) Regulations 2009. S.I. No. 286 of 2009.
11. Erikson 1997. Analytical Chemistry of PCBs, Michael D Erikson, Lewis Publishers, 2nd edition, 1997. Pages 79-85
12. EC (European Commission) 2001. Council Regulation (EC) No 2375/2001 of 29 November 2001 amending Commission Regulation (EC) No 466/2001 setting maximum levels for certain contaminants in foodstuffs.
13. EC (European Commission) 2008. Final Report of a Mission carried out in India to Gather Information on the source of Contamination of Gum with Pentachlorophenol and Dioxins. DG (SANCO) 2007-7619 final.

14. DEFRA 2001. Dioxins and Dioxin-like PCBs in the UK Environment. Dept. of Environment, Food and Rural Affairs, DEFRA Publications, London.
15. Gallani et al, 2004. Gallani, B., Verstraeter, F., Boix, A., von Holst, C., Anklam, E., Levels of dioxins and dioxin-like PCBs in food and feed in Europe, Organohalogen Compounds, **66**, 1893-1900, 2004.
16. Hamm et al 2005. Stephan Hamm, Rainer Grümping, Jurgen Schwietering. Organohalogen Compounds, **67**, 1406-1408, 2005
17. Schuda et al 2004. Schuda, L, Schaum J., Lorber M., Ferrario, J and Sears R. Organohalogen Compounds, **66**, 1952-1957, 2004.
18. Durand et al. 208. Benoit Durand, Barbara Dufour, Daniel Fraisse, Stéphanie Defour, Koenraad Duhem, Karine Le-Barillec. Levels of PCDDs, PCDFs and dioxin-like PCBs in raw cow's milk collected in France in 2006. Chemosphere Volume 70, Issue 4, January 2008, Pages 689-693
19. FSA (Food Standards Agency). 2006. Dioxins and dioxin-like PCBs in foods – EU monitoring 2005. Food Survey Information Sheet, 16/06. http://www.food.gov.uk/science/surveillance/fsisbranch2006/fsis1606
20. FSA (Food Standards Agency). 2007. Dioxins and dioxin-like PCBs in foods – EU monitoring 2006. Food Survey Information 04/07 Sheet.http://www.food.gov.uk/science/surveillance/fsisbranch2007/fsis0407
21. EC (European Commission) 2006 (1). COMMISSION REGULATION (EC) No 199/2006 of 3 February 2006 amending Regulation (EC) No 466/2001 setting maximum levels for certain contaminants in foodstuffs as regards dioxins and dioxin-like PCBs
22. EC (European Commission) 2006 (2). COMMISSION RECOMMENDATION of 6 February 2006 on the reduction of the presence of dioxins, furans, and PCBs in feedingstuffs.and foodstuffs.
23. FSAI (Food Safety Authority of Ireland) 2006. Rainer Grümping, Malte Petersen, Arnold Kuchen, Christina Tlustos. Levels Of Polybrominated Diphenyl Ethers In Swiss And Irish Cow's Milk, Organohalogen Compounds **68** (2006)
24. Grümping and Petersen 2007, Rainer Grümping and Malte Petersen. Organohalogen Compounds **69**, 912-915 (2007)
25. Fuerst 2007. PCDD/PCDF and PCB in Dairy Products from North-Rhine Westphalia 2006 as Compared to Levels since 1990. Organohalogen Compounds **69** (2007)
26. U.S. EPA (Environmental Protection Agency). 2006. An inventory of sources and environmental releases of dioxin-like compounds in the United States for the years 1987, 1995, and 2000. National Center for Environmental Assessment, Washington, DC; EPA/600/P-03/002F. (http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=159286)
27. DEFRA 2006. Emissions of Dioxins and Dioxin-like Polychlorinated Biphenyls from Domestic Sources. Dept. for Environment, Food and Rural Affairs, DEFRA Publications, London.
28. FSAI (Food Safety Authority of Ireland) 2005. Investigation into levels of Dioxins, Furans, PCBs and PBDEs in Irish food 2004. http://www.fsai.ie/publications/reports/dioxins.pdf
29. HPA 2009. The Impact on Health of Emissions to Air from Municipal Waste Incinerators. UK Health Protection Agency. September 2009. http://www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1251473372218

Bibliography

1. European Dioxin Inventory, North Rhine-Westphalia State Environment Agency on behalf of the European Commission, DG XI,

http://europa.eu.int/comm/environment/dioxin/download.htm, 1997 (Stage 1), 2000 (Stage 2).

2. Compilation of EU Dioxin exposure and health data, AEA Technology, produced for the European Commission, DG Environment and UK Department of the Environment, Transport and the Regions, http://europa.eu.int/comm/environment/dioxin/download.htm, 1999.

3. Dioxins and Health Arnold Schecter (Editor) and Thomas A. Gasiewicz (Editor). Wiley-Interscience; 2nd edition, June 2003.

4. Analytical Chemistry of PCBs, Michael D Erikson, Lewis Publishers, 2nd edition, 1997

Glossary

"A" samples	background samples covering the entire country
"B" samples	potential impact samples from areas of perceived potential risk
2,4,5-T	2,4,5-trichlorophenoxyacetic acid
2,4-D	2,4-dichlorophenoxyacetic acid
Aliphatic chemicals	organic chemicals which do not contain benzene rings
Aromatic chemicals	organic chemicals containing benzene rings
BFRs	brominated flame retardants
dielectric constant	capacity to store electrical energy
EPA	Environmental Protection Agency (Ireland)
G	gramme
GfA	Gesellschaft für Arbeitsplatz und Umweltanalytik laboratory, Münster, Germany
IPC	Integrated Pollution Control
I-TEQ	Toxic Equivalent (weighted toxicity of a mixture of dioxin congeners expressed as PCDD) using NATO convention
lipophilic	refers to the tendency of a substance to dissolve in fats or oils
LOD	limit of detection
LOQ	limit of quantification
NATO	North Atlantic Treaty Organisation
Precursor	A substance from which another substance is formed
PBDEs:	polybrominated diphenyl ethers
PBDD	polybrominated dibenzo-para-dioxin
PBDF	polybrominated dibenzofuran
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo-para-dioxin
PCDF	polychlorinated dibenzofuran
Pg	picogram, 10^{-12} of a gramme.
TEF	Toxic Equivalent Factor (toxicity weighting factor for individual congeners)
USEPA	Environmental Protection Agency (United States)
WHO	World Health Organisation
WHO TEQ	Toxic Equivalent (weighted toxicity of a mixture of dioxin congeners expressed as PCDD) using WHO convention

Annex 1

Toxicity Equivalent Factors (TEFs) used for calculation of I-TEQs and WHO-TEQs

PCDD/F parameter	I-TEF	WHO-TEF (1998)
PCDFs		
2,3,7,8-TetraCDF	0,1	0,1
1,2,3,7,8-PentaCDF	0,05	0,05
2,3,4,7,8-PentaCDF	0,5	0,5
1,2,3,4,7,8-HexaCDF	0,1	0,1
1,2,3,6,7,8-HexaCDF	0,1	0,1
2,3,4,6,7,8-HexaCDF	0,1	0,1
1,2,3,7,8,9-HexaCDF	0,1	0,1
1,2,3,4,6,7,8-HeptaCDF	0,01	0,01
1,2,3,4,7,8,9-HeptaCDF	0,01	0,01
OctaCDF	0,001	0,0001
PCDDs		
2,3,7,8-TetraCDD	1,0	1,0
1,2,3,7,8-PentaCDD	0,5	1,0
1,2,3,4,7,8-HexaCDD	0,1	0,1
1,2,3,6,7,8-HexaCDD	0,1	0,1
1,2,3,7,8,9-HexaCDD	0,1	0,1
1,2,3,4,6,7,8-HeptaCDD	0,01	0,01
OctaCDD	0,001	0,0001

PCB congeners		WHO-TEF (1998)
Chlorosubstitution Pattern	**IUPAC Number**	
3,4,4‘,5-Tetrachlorobiphenyl	PCB 81	**0,0001**
3,3‘,4,4‘-Tetrachlorobiphenyl	PCB 77	**0,0001**
2‘,3,4,4‘,5-Pentachlorobiphenyl	PCB 123	**0,0001**
2,3‘,4,4‘,5-Pentachlorobiphenyl	PCB 118	**0,0001**
2,3,4,4‘,5-Pentachlorobiphenyl	PCB 114	**0,0005**
2,3,3‘,4,4‘-Pentachlorobiphenyl	PCB 105	**0,0001**
3,3‘,4,4‘,5,-Pentachlorobiphenyl	PCB 126	**0,1**
2,3‘,4,4‘,5,5‘-Hexachlorobiphenyl	PCB 167	**0,00001**
2,3,3‘,4,4‘,5-Hexachlorobiphenyl	PCB 156	**0,0005**
2,3,3‘,4,4‘,5‘-Hexachlorobiphenyl	PCB 157	**0,0005**
3,3‘,4,4‘,5,5‘-Hexachlorobiphenyl	PCB 169	**0,01**
2,3,3‘,4,4‘,5,5‘-Heptachlorobiphenyl	PCB 189	**0,0001**

Annex 2

Laboratory reports from GfA

These can be found at the links below.

Dioxin Results 2008 http://www.epa.ie/downloads/pubs/other/dioxinresults

Brominated Flame Retardants 2008: http://www.epa.ie/downloads/pubs/other/dioxinresults

An Ghníomhaireacht um Chaomhnú Comhshaoil

Is í an Gníomhaireacht um Chaomhnú Comhshaoil (EPA) comhlachta reachtúil a chosnaíonn an comhshaol do mhuintir na tíre go léir. Rialaímid agus déanaimid maoirsiú ar ghníomhaíochtaí a d'fhéadfadh truailliú a chruthú murach sin. Cinntímid go bhfuil eolas cruinn ann ar threochtaí comhshaoil ionas go nglactar aon chéim is gá. Is iad na príomh-nithe a bhfuilimid gníomhach leo ná comhshaol na hÉireann a chosaint agus cinntiú go bhfuil forbairt inbhuanaithe.

Is comhlacht poiblí neamhspleách í an Ghníomhaireacht um Chaomhnú Comhshaoil (EPA) a bunaíodh i mí Iúil 1993 faoin Acht fán nGníomhaireacht um Chaomhnú Comhshaoil 1992. Ó thaobh an Rialtais, is í an Roinn Comhshaoil agus Rialtais Áitiúil a dhéanann urraíocht uirthi.

ÁR bhFREAGRACHTAÍ

CEADÚNÚ

Bíonn ceadúnais á n-eisiúint againn i gcomhair na nithe seo a leanas chun a chinntiú nach mbíonn astuithe uathu ag cur sláinte an phobail ná an comhshaol i mbaol:

- áiseanna dramhaíola (m.sh., líonadh talún, loisceoirí, stáisiúin aistrithe dramhaíola);
- gníomhaíochtaí tionsclaíocha ar scála mór (m.sh., déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta);
- diantalmhaíocht;
- úsáid faoi shrian agus scaoileadh smachtaithe Orgánach Géinathraithe (GMO);
- mór-áiseanna stórais peitreail.
- Scardadh dramhuisce

FEIDHMIÚ COMHSHAOIL NÁISIÚNTA

- Stiúradh os cionn 2,000 iniúchadh agus cigireacht de áiseanna a fuair ceadúnas ón nGníomhaireacht gach bliain.
- Maoirsiú freagrachtaí cosanta comhshaoil údarás áitiúla thar sé earnáil - aer, fuaim, dramhaíl, dramhuisce agus caighdeán uisce.
- Obair le húdaráis áitiúla agus leis na Gardaí chun stop a chur le gníomhaíocht mhídhleathach dramhaíola trí comhordú a dhéanamh ar líonra forfheidhmithe náisiúnta, díriú isteach ar chiontóirí, stiúradh fiosrúcháin agus maoirsiú leigheas na bhfadhbanna.
- An dlí a chur orthu siúd a bhriseann dlí comhshaoil agus a dhéanann dochar don chomhshaol mar thoradh ar a ngníomhaíochtaí.

MONATÓIREACHT, ANAILÍS AGUS TUAIRISCIÚ AR AN GCOMHSHAOL

- Monatóireacht ar chaighdeán aeir agus caighdeáin aibhneacha, locha, uiscí taoide agus uiscí talaimh; leibhéil agus sruth aibhneacha a thomhas.
- Tuairisciú neamhspleách chun cabhrú le rialtais náisiúnta agus áitiúla cinntí a dhéanamh.

RIALÚ ASTUITHE GÁIS CEAPTHA TEASA NA HÉIREANN

- Cainníochtú astuithe gáis ceaptha teasa na hÉireann i gcomhthéacs ár dtiomantas Kyoto.
- Cur i bhfeidhm na Treorach um Thrádáil Astuithe, a bhfuil baint aige le hos cionn 100 cuideachta atá ina mór-ghineadóirí dé-ocsaíd charbóin in Éirinn.

TAIGHDE AGUS FORBAIRT COMHSHAOIL

- Taighde ar shaincheisteanna comhshaoil a chomhordú (cosúil le caighdeán aeir agus uisce, athrú aeráide, bithéagsúlacht, teicneolaíochtaí comhshaoil).

MEASÚNÚ STRAITÉISEACH COMHSHAOIL

- Ag déanamh measúnú ar thionchar phleananna agus chláracha ar chomhshaol na hÉireann (cosúil le pleananna bainistíochta dramhaíola agus forbartha).

PLEANÁIL, OIDEACHAS AGUS TREOIR CHOMHSHAOIL

- Treoir a thabhairt don phobal agus do thionscal ar cheisteanna comhshaoil éagsúla (m.sh., iarratais ar cheadúnais, seachaint dramhaíola agus rialacháin chomhshaoil).
- Eolas níos fearr ar an gcomhshaol a scaipeadh (trí cláracha teilifíse comhshaoil agus pacáistí acmhainne do bhunscoileanna agus do mheánscoileanna).

BAINISTÍOCHT DRAMHAÍOLA FHORGHNÍOMHACH

- Cur chun cinn seachaint agus laghdú dramhaíola trí chomhordú An Chláir Náisiúnta um Chosc Dramhaíola, lena n-áirítear cur i bhfeidhm na dTionscnamh Freagrachta Táirgeoirí.
- Cur i bhfeidhm Rialachán ar nós na treoracha maidir le Trealamh Leictreach agus Leictreonach Caite agus le Srianadh Substaintí Guaiseacha agus substaintí a dhéanann ídiú ar an gcrios ózóin.
- Plean Náisiúnta Bainistíochta um Dramhaíl Ghuaiseach a fhorbairt chun dramhaíl ghuaiseach a sheachaint agus a bhainistiú.

STRUCHTÚR NA GNÍOMHAIREACHTA

Bunaíodh an Ghníomhaireacht i 1993 chun comhshaol na hÉireann a chosaint. Tá an eagraíocht á bhainistiú ag Bord lánaimseartha, ar a bhfuil Príomhstiúrthóir agus ceithre Stiúrthóir.

Tá obair na Gníomhaireachta ar siúl trí ceithre Oifig:

- An Oifig Aeráide, Ceadúnaithe agus Úsáide Acmhainní
- An Oifig um Fhorfheidhmiúchán Comhshaoil
- An Oifig um Measúnacht Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáide

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag ball air agus tagann siad le chéile cúpla uair in aghaidh na bliana le plé a dhéanamh ar cheisteanna ar ábhar imní iad agus le comhairle a thabhairt don Bhord.

Environmental Protection Agency

The Environmental Protection Agency (EPA) is a statutory body responsible for protecting the environment in Ireland. We regulate and police activities that might otherwise cause pollution. We ensure there is solid information on environmental trends so that necessary actions are taken. Our priorities are protecting the Irish environment and ensuring that development is sustainable.

The EPA is an independent public body established in July 1993 under the Environmental Protection Agency Act, 1992. Its sponsor in Government is the Department of the Environment, Heritage and Local Government.

OUR RESPONSIBILITIES

LICENSING

We license the following to ensure that their emissions do not endanger human health or harm the environment:

- waste facilities (e.g., landfills, incinerators, waste transfer stations);
- large scale industrial activities (e.g., pharmaceutical manufacturing, cement manufacturing, power plants);
- intensive agriculture;
- the contained use and controlled release of Genetically Modified Organisms (GMOs);
- large petrol storage facilities.
- Waste water discharges

NATIONAL ENVIRONMENTAL ENFORCEMENT

- Conducting over 2,000 audits and inspections of EPA licensed facilities every year.
- Overseeing local authorities' environmental protection responsibilities in the areas of - air, noise, waste, waste-water and water quality.
- Working with local authorities and the Gardaí to stamp out illegal waste activity by co-ordinating a national enforcement network, targeting offenders, conducting investigations and overseeing remediation.
- Prosecuting those who flout environmental law and damage the environment as a result of their actions.

MONITORING, ANALYSING AND REPORTING ON THE ENVIRONMENT

- Monitoring air quality and the quality of rivers, lakes, tidal waters and ground waters; measuring water levels and river flows.
- Independent reporting to inform decision making by national and local government.

REGULATING IRELAND'S GREENHOUSE GAS EMISSIONS

- Quantifying Ireland's emissions of greenhouse gases in the context of our Kyoto commitments.
- Implementing the Emissions Trading Directive, involving over 100 companies who are major generators of carbon dioxide in Ireland.

ENVIRONMENTAL RESEARCH AND DEVELOPMENT

- Co-ordinating research on environmental issues (including air and water quality, climate change, biodiversity, environmental technologies).

STRATEGIC ENVIRONMENTAL ASSESSMENT

- Assessing the impact of plans and programmes on the Irish environment (such as waste management and development plans).

ENVIRONMENTAL PLANNING, EDUCATION AND GUIDANCE

- Providing guidance to the public and to industry on various environmental topics (including licence applications, waste prevention and environmental regulations).
- Generating greater environmental awareness (through environmental television programmes and primary and secondary schools' resource packs).

PROACTIVE WASTE MANAGEMENT

- Promoting waste prevention and minimisation projects through the co-ordination of the National Waste Prevention Programme, including input into the implementation of Producer Responsibility Initiatives.
- Enforcing Regulations such as Waste Electrical and Electronic Equipment (WEEE) and Restriction of Hazardous Substances (RoHS) and substances that deplete the ozone layer.
- Developing a National Hazardous Waste Management Plan to prevent and manage hazardous waste.

MANAGEMENT AND STRUCTURE OF THE EPA

The organisation is managed by a full time Board, consisting of a Director General and four Directors.

The work of the EPA is carried out across four offices:

- Office of Climate, Licensing and Resource Use
- Office of Environmental Enforcement
- Office of Environmental Assessment
- Office of Communications and Corporate Services

The EPA is assisted by an Advisory Committee of twelve members who meet several times a year to discuss issues of concern and offer advice to the Board.