DIOXIN LEVELS IN MILK AND FOOD PAPER PACKAGING PRODUCTS

Late 1989 - 1991

A followup survey monitoring the dioxin levels in milk products, and an initial investigation of dioxin levels in some food paper packaging products.

Food Administration
Ministry of Health
PO Box 5013
Wellington
New Zealand

Author: Janine Manhart
With review and advice:
Simon Buckland (ESR)
Martin Edwards (MOH)
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TABLE OF CONTENTS

GLOSSARY

Dioxin(s) The term "dioxin" usually refers to a group of related chemical compounds, some of which are considered very toxic. The chemical names are polychlorinated dibenzo-para dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). In this report the term "dioxin(s)" without other qualification includes any or all of these compounds.

Half life The time period over which half the original amount of a compound is degraded.

ppt Parts per trillion. This is equivalent to 1 part in 1,000 000 000 000
Equivalent units are pg/g (picograms per gram)
One picogram = 1×10^{-12}g
or ng/kg (nanograms per kilogram)
One nanogram = 1×10^{-9}g

TTE (Total Toxic Equivalents). To simplify results of a dioxin analysis, a number of toxic equivalent factors have been developed. These values convert levels of individual dioxins into one number of TTE i.e. the 2378-TCDD equivalent value for the sample, where 2378-TCDD has the standard factor of 1. Most of the results in this report have been calculated using values derived by the Nordic Expert Group.[2]

Nordic TWI The Nordic Tolerable Weekly Intake is a calculated level of acceptable intake of dioxin over a life time of exposure. Risk assessment in establishing this benchmark is done by extrapolating animal test results to potential human exposure levels. The Nordic Council used a level of 0.001 micrograms/kg body weight/day which was the level of no observed adverse effect limit (NOAEL) in the rat, with a 200 fold "safety factor". The Tolerable Weekly Intake is given as 35 pg/kg body weight/week. The Nordic Council established a weekly intake rather than a daily intake due to dioxin's long half life and the fact that life-long exposure was being considered.

NATO The North Atlantic Treaty Organisation committee on Challenges to Modern Society proposed a system for TEQ's (toxic equivalents) that has been most widely accepted around the world. This is known as the International Toxic Equivalent Factor (I-TEF) system.[6]

Limit of Detection (LOD) The level below which the presence of a contaminant in a sample cannot be quantified. It is difficult to analyse dioxins , and so this figure varies from sample to sample. In some cases, the LOD for one sample between analyses may be higher than the level reported for another sample.

Abbreviations used for individual sample results

CDD = chlorodibenzo-p-dioxin CDF = chlorodibenzofuran
T = tetra Pe = penta Hx = hexa Hp = hepta O = octa TE = Toxic equivalent

SUMMARY

In March 1989 a survey was undertaken testing the levels of dioxin in milk and cream offered for retail sale in New Zealand. The results showed that dioxin leached from the paperboard packaging into the milks and creams, but the Department did not consider these results a risk to health.

However, the dioxin from the milk and cream was considered as contributing unnecessarily to the body burden of dioxin. The Department of Health undertook to work with the milk and paperboard packaging industries to reduce the dioxin level as far as practicable.

In November 1989 - April 1991 The Department of Health carried out a follow up survey on milk samples for levels of dioxin. Samples were also taken of other paper products that contact food i.e. butter paper, teabags, coffee filters, and wax paper separating meat.

The purpose of the second survey on milk was to determine the levels of dioxin in milk packaged in paperboard cartons at this time, and to see if dioxin levels had reduced since the March 1989 survey. The food packaging samples were used as an indication of likely dioxin levels.

Area Health Boards sampled milk in plastic and paperboard cartons. These and other food paper products were all tested at DSIR Chemistry for levels of dioxins.

Milk from plastic containers showed only trace levels of dioxin. This reiterated results from the previous survey (March 1989) concluding that milk in plastic packaging contained virtually undetectable levels of dioxin.

The range of values found for Total Toxic Equivalents (Nordic Basis) for milk from paperboard cartons were 0.006 - 0.051ppt. These values were markedly reduced from the 1989 survey levels, which in comparison ranged from 0.012 - 0.216 ppt.

Based on the results found in the survey, paperboard packaging as a source of dioxin is contributing only a small percentage of the tolerable dioxin intake, and is not considered any threat to health. The significance of the results in relation to the Nordic Council Tolerable Weekly Intake (TWI) indicate that at the level of dioxin found, a 70 kg person drinking seven litres of milk a week would account for only 14% of their TWI for dioxin.

Significant conclusions cannot be drawn from the results for food paper packaging, as only single composite samples were tested.

Levels of dioxins found in the other paper packaging products in ppt were: tea bags 0.27, coffee filter 10.7, butter paper 0.87, and meat paper 3.2. The tea bags and the coffee filters were the only products that could be compared with overseas data.

The TTE level in coffee filters was compared with U.S. data and indicated a very low likelihood for consumers using the filters, of exceeding the estimated maximum daily dioxin intake. The TTE level found in the New Zealand coffee filter sample was higher than levels found in coffee filters from U.S.A. and Swedish data, indicating levels may be higher than necessary.

Results for tea bags were compared with U.S. data. It was concluded that based on the limited sample information, it would be unlikely that New Zealand would get close to a maximum daily dioxin level by drinking tea made with bleached tea bags.

The results here indicate that New Zealanders would not get a significant contribution to total exposure to dioxins from using tea bags and coffee filters.

BACKGROUND

The Department of Health in conjunction with the milk and paperboard industry undertook some monitoring of milk for levels of dioxin, over the period November 1989 to April 1991. The sampling was to determine if levels of dioxin had decreased in milk since previous surveys. Other food paper packaging products were also investigated for presence of dioxin.

This report covers the results of these tests.

The impetus behind the earlier 1989 survey arose from concern in Canada and the U.S in the late 1980's about trace levels of dioxins in milk packaged in paper board cartons. Paper board packaging was increasing on the New Zealand market at this time. The Department of Health considered it important to determine dioxin levels in local product.

The Department of Health in conjunction with DSIR Chemistry undertook the original survey in March - April 1989 to test dioxin levels in New Zealand milk packaged in paperboard cartons.

Initially a small number of samples were independently obtained and analysed by the DSIR. On becoming aware of the results the Department of Health decided to carry out its own wider ranging study; more representative of New Zealand overall. This was carried out in March - April 1989, and a report presented by DSIR Chemistry and the Department of Health on 11 May 1989. "A Survey Of Some New Zealand Retail Milk Supplies For The Presence Of Dioxin, March - April 1989".[1] The Department of Health made results of this survey public.

It was concluded from that original survey that milk prior to packaging, or packed in glass or plastic contained virtually undetectable levels of dioxin. Paperboard packaging was found to leach dioxins into milk and cream, but not at a level considered a health risk. It was concluded however, that the presence of dioxin from these sources was unnecessary and undesirable, as packaging was available that did not leach dioxin into milk and cream i.e. glass, plastic and paperboard alternatives.

The Department of Health thereafter worked with industry to prevent as much as possible, contamination of milk and cream with dioxin. The milk and paperboard industries took action to prevent dioxin leaching into milk by sourcing low dioxin packaging.

Further details of the original survey can be obtained from the report "A Survey Of Some New Zealand Retail Milk Supplies For The Presence Of Dioxin March - April 1989".

PURPOSE OF THIS SURVEY:

To determine the levels of dioxin in milk packed in paperboard cartons, and see if dioxin levels had reduced since the March - April 1989 survey.

To determine levels of dioxin in other paper products contacting food, and verify the significance of these levels to public health.

SAMPLING AND METHODOLOGY

Each of six Area Health Boards obtained three samples of standard milk over the period late 1989 through mid 1991. Each board sampled two 1 Litre paperboard cartons of the same brand, and one 2 Litre plastic container.

The 2 cartons of identical product were from different retail outlets, but with the same packing date.

In total this resulted in six milk samples of both Purepak and Tetrapak brand cartons and six plastic milk containers. Tetrapak and Purepak cartons are the two types of carton used in New Zealand for packaging milk.

These samples were dispatched to DSIR Chemistry. All samples were individually analysed 5 days after the day of packing.

In February 1991 some isolated sampling of other paper products that contact food were also tested for dioxin levels. These included tea bags, coffee filters, butter paper and meat pattie wax paper.

All samples were extracted and purified, and measurements performed using high resolution capillary chromatography and high resolution electron impact mass spectrometry. For more detail on the testing method see Appendix A13.

Samples that were tested are detailed in Table 1.

Table 1 Samples tested for dioxin.

Sample	**Area obtained**	**Date received**	
Blank (distilled water)		Various	
2L plastic std milk	Wellington	6 Nov	1989
2 x 1L carton std milk	Wellington	6 Nov	1989
2L plastic std milk	Northland	10 Nov	1989
2 x 1L carton std milk	Northland	10 Nov	1989
2L plastic std milk	Auckland	6 June	1990
2 x 1L carton std milk	Auckland	6 June	1990
2L plastic std milk	Hawkes Bay	11 May	1990
2 x 1L carton std milk	Hawkes Bay	11 May	1990
2L plastic std milk	Christchurch	30 April	1991
2 x 1L carton std milk	Christchurch	30 April	1991
2L plastic std milk	Manawatu	15 April	1991
2 x 1L carton std milk	Manawatu	15 April	1991
Choysa teabags	Wellington	9 Feb	1990
Faggs coffee filter bags	Wellington	9 Feb	1990
Fernleaf butter paper	Wellington	9 Feb	1990
Wax paper ex meat patties	Wellington	9 Feb	1990

RESULTS AND DISCUSSION

(1) MILK RESULTS

1.1 Individual results

The condensed summary of results for tetrachlorodibenzofurans (TCDF) and total toxic equivalents (TTE) for the individual milk samples taken, is given in Table A1 of the Appendix.

Specific dioxin compounds tested

In this table figures are given for the levels of 2,3,7,8-tetrachlorodibenzofuran (2378-TCDF) and 1,2,7,8-tetrachlorodibenzofuran (1278-TCDF). These compounds are formed from the chlorine bleaching of kraft pulp.

Total toxic equivalent values

A figure is also given for the Total Toxic Equivalents (TTE). To calculate this, each of the dioxin compounds is given a toxicity factor in relation to the extremely toxic dioxin 2,3,7,8-tetrachlorodibenzo-para-dioxin (TCDD); which is given a value of 1. This factor is multiplied by the level of dioxin found for that compound, and the additive result for all the dioxin compounds present is the Total Toxic Equivalent. The TTE is calculated using the (Nordic Basis) values derived by the Nordic Expert Group[2].

Figures are given for the dioxins and TTE in both the fat component of the milk and the whole milk. Dioxins have a high affinity for lipid materials and fat contents vary in milk. Thus the fat component is another way of comparing dioxin levels. However, what is significant is the individual's total exposure to dioxin.

A short summary of average TTE levels found in paperboard cartons from regions is given in Table 2 on the following page. Levels are expressed in ppt.

In defining this TTE level some of the values that add up to the TTE were found at less than the limit of detection and in such cases half the limit of detection is used as a value.

Table 2 Average Total Toxic Equivalents found in cartoned milk

Region	Type Of Pack	TTE (fat)	TTE (Whole Milk)
Northland	Purepak	0.24	0.007
Hawkes Bay	Purepak	0.27	0.009
Manawatu	Purepak	0.21	0.007
Auckland	Tetrapak	1.37	0.045
Wellington	Tetrapak	0.66	0.020
Christchurch	Tetrapak	0.26	0.008

There are a number of alternative Toxic Equivalent values in use around the world. This makes direct comparison between results from different sources difficult. The most widely accepted system is known as the I-TEF or International Toxic Equivalent Factor System that was proposed by the NATO committee.

Also used is the Nordic system by Scandinavian countries. Germany has its own system and the U.S.A use the U.S Environmental Protection Agency's (EPA) system.

The complete individual results for dioxin levels found in each of the milk samples taken, are given on pages A3 - A11 of the Appendix.

1.2 Packaging Form

The test results for milk packaged in plastic containers showed only trace levels of dioxin, reiterating the results of the previous survey concluding that milk in plastic packaging contained virtually undetectable levels of dioxin.

The condensed summary of comparison of results with the 1989 survey is given in Table 3 on the following page. The full summary is given in Table A2 of the Appendix. Where appropriate, dioxin levels detected are given for the same areas in the different surveys. The areas are split up into those using the two different packaging types. This is represented in graphical form in Fig 1, page A14.

Table 3 Comparison of Total Toxic Equivalents between original dioxin survey levels and subsequent monitoring of standard milk.

Packaging : Tetrapak	**Milk Fat (ppt)**		**Whole milk (ppt)**	
Area	TTE (Surv)	TTE (Mon)	TTE (Surv)	TTE (Mon)
Wellington	6.86	0.66	0.099	0.020
Auckland	6.25	1.37	0.131	0.045
Christchurch	4.14	0.26	0.125	0.008
Packaging : Purepak	**Milk Fat (ppt)**		**Whole milk (ppt)**	
Area	TTE (Surv)	TTE (Mon)	TTE (Surv)	TTE (Mon)
Hawkes Bay	0.77	0.27	0.026	0.0089
Greymouth	0.91		0.029	
Northland		0.24		0.007
Manawatu		0.21		0.0067

TTE (Sur) = The average total toxic equivalents detected in the March/April 1989 dioxin survey.
TTE (Mon) = The average total toxic equivalents detected in dioxin monitoring following the 1989 survey.

In all areas that sampled cartoned milk, dioxin levels detected were markedly reduced from the 1989 survey levels. In some cases a 20 fold reduction was seen. The levels of 2378-TCDF and 1278-TCDF have greatly reduced in comparison to the 1989 survey, indicating the source of paperboard is providing lower levels of these dioxins.

Tetrapak packaging showed higher dioxin levels than Purepak in the original survey. Both types had significantly reduced dioxin with respect to these original levels. New Zealand sourced paper packaging is produced by Tetrapak Australia Pty Limited, and Purepak in Australia by Gadsden Rheem. The differences in levels are due to different sources of wood-pulp, pulping and bleaching technology and production techniques.

1.3 Significance of results

Milk packaged in plastic bottles contained virtually undetectable levels of dioxin.

The results of this survey show the paperboard packaging being used in New Zealand from late 1989 by Tetrapak and Purepak leached very small amounts of dioxin into milk. However, the level of dioxin in milk from paperboard packaging has reduced 10-20 times since the previous survey. Low dioxin packaging was sourced, after the results of the original survey were known.

1.4 Intake

A U.K. expert group, the Committee On Toxicity Of Chemicals In Food, Consumer Products And The Environment made a comprehensive statement on dioxins in 1989. They concluded (in Department of the Environment Pollution Paper no. 27 (Dioxins in the environment)), that food is likely to be the major route of exposure of the general population to dioxins and furans.

The Nordic Council, Sweden, set a tolerable weekly intake of 35 picograms/kg body weight/week. They adopted the weekly concept due to the long biological half life of most of the PCDD's and PCDF's, and taking into account that life-long exposure occurs. This allows for daily flucuations of intake giving a weekly average.

Table 4 lists the results using a similar example as in the previous survey[1] to estimate the contribution of dioxin levels in milk to the Nordic Tolerable Weekly intake.

Table 4 Contribution of dioxin from milk to the Nordic Tolerable Weekly Intake (TWI), expressed as a percentage.

	Dioxin equivalent level in milk (ppt)		
	0.01	**0.05**	**0.1**
	Percentages of TWI (%)		
30kg[a] person drinking two litres of milk/week	1.90	9.6	19
30kg person drinking seven litres of milk/week	6.66	33.3	66.6[c]
70kg[b] person drinking two litres of milk/week	0.82	4.1	8.2
70kg person drinking seven litres of milk/week	2.85	14.3	28.7

a Approximate age of nine years
b An average adult male
c Two litres of milk per week = the approximate New Zealand average consumption.
Seven litres of milk per week = 3 and a half times the average consumption.
The Nordic tolerable weekly intake is based on a lifetime of exposure. Relatively high intakes such as this level (66.6%) in relation to the TWI which occur infrequently during the lifespan, would not be anticipated to have any adverse effects.

Most of the TTE results in this survey were at levels of 0.01 ppt or less. Therefore looking at the above table, the dioxin in cartoned milk is contributing only a very small percentage of the Nordic tolerable dioxin intake for a week.

An expert group convened by the WHO regional office for Europe (WHO/EURO) recommended a Tolerable Daily Intake (TDI) of 10 pg/kg body weight/day for 2378-TCDD which is equivalent to 600 pg TEQ/day for a 60 kg person. It is of interest to note the average dietary intake for dioxins and furans in the UK (125 pg TEQ/day for a 60 kg person) is considerably below this recommended TDI. This TDI works out at twice the TWI used by the Nordic group, so any % values are in respect to the particular system used.

A worst case scenario example was worked through using a high milk consumption value (1 litre/day) and using a dioxin level in the milk of 0.051 ppt (the highest level found in this survey), calculated for a 30 kg and a 70 kg person. The contributions of dioxin from cartoned milk as a percentage of the WHO/EURO tolerable daily intake in this scenario are as follows:

30 kg person drinking 1 litre of milk per day = 17 % of the TDI
70 kg person drinking 1 litre of milk per day = 7.3 % of the TDI

1.5 Dioxin levels in cartons

It was of interest in this study to find out the actual levels of dioxin in the cartons themselves. Information was received from the association of liquid paperboard carton manufacturers of Australia (ALC), which supply Tetra Pak and Pure Pak cartons to New Zealand. They state "Since the issue first arose considerable resources have been devoted to ensuring the bleaching processes used for milk carton board do not lead to an increased level of dioxin in the board, beyond background levels. Recent analysis confirm this. Local milk carton manufacturers (Western Australia) have set a ceiling level for dioxins in paperboard at one part per trillion (TCDD equivalents) and analysis of current board production shows this level is not reached."

(2) FOOD PAPER PACKAGING RESULTS

There is known potential for dioxin compounds to leach out of paper during certain applications.

In this study the following food paper packaging was tested for presence of dioxins : Tea bags, coffee filters, butter paper, and the wax paper separating meat patties.

Individual results for each of the food paper packaging products are given on page A12 of the Appendix. In Table 5 below figures are summarised for levels of 2378-TCDF and 1278-TCDF and TTE.

Table 5 Dioxin results for food paper packaging products (ppt)

Product	2378 TCDF*	1278 TCDF*	TTE
Tea Bags	0.12	0.055	0.27
Coffee filter	28.4	10.6	10.7
Butter paper	3.1	1.2	0.87
Meat paper	11.3	6.2	3.2

* 2378-TCDF = 2,3,7,8-Tetrachlorodibenzofuran
* 1278-TCDF = 1,2,7,8-Tetrachlorodibenzofuran

To determine the significance of these results, information that was available on similar products tested overseas was compared directly.

Two American studies looked at the potential dioxin exposure through coffee or tea brewed, using bleached pulp coffee filters or tea bags (M.J.Sullivan et al, 1989)[3]. A Swedish study looked at levels of dioxins in bleached and unbleached coffee filters (Var Foda, 1988)[4].

Coffee Filters

Table 6 compares the levels of several dioxins levels found in Swedish and New Zealand coffee filters.

Table 6 Dioxin levels in Swedish and New Zealand coffee filters (ppt)

	Sweden		New Zealand
Component	Unbleached	Bleached	Bleached
2378 TCDF	13	22	28.4
2378 TCDD	2.0	5.0	7.1
23478 PeCDF	0.29	0.91	0.61
12378 PeCDD	<0.4	0.58	0.42
TTE	3.8	8.2	10.7

The New Zealand (NZ) sample was one composite sample as detailed in Appendix 13 Sample details of the Swedish sample are not known. The TTE for the NZ sample was calculated using NATO toxic equivalents, but for the purpose of this comparison it was converted to Nordic Basis TTE.

The NZ level is slightly higher than levels found in bleached coffee filters from Sweden.

Average dioxin levels found in an American study of bleached coffee filters are compared to levels found in NZ in Table 7 below.

Table 7 Average dioxin levels in American and NZ coffee filters

Country	2378-TCDF (ppt)	USEPA TCDD TTE (ppt)
U.S.A	15.3 (Av)	4.3 (Av)
New Zealand	28.4	10.4 (TTE)*

* NZ TTE has been converted to USEPA TCDD TEQ.

Levels of dioxin in the New Zealand coffee filter sample is almost double the U.S.A levels, but it must be realized only one composite sample was tested in NZ. The U.S.A study looked at 7 samples including levels found in the literature. Also no extraction method details were given in the U.S.A. paper[3b] and the NZ methods may have been different to those used in the U.S.A. This may account for some of the differences observed.

At best these comparisons can only give a very vague indication of the significance of the NZ results. However despite this it seems the level in coffee filters could be higher than necessary. This is an area for work in the future.

In the American study, the population exposure was assessed, coffee brewing practices reviewed and the dioxin migration rates into the coffee measured. They used a quantitative estimate of the risk, and an exposure model, and calculated a lifetime average daily dose.

The allowable maximum dioxin concentration in bleached paper coffee filters for the two exposure scenarios worked out in the study are as follows:

(a) Average drinker consuming 3.4 cups of coffee per day 365 days of the year. The lower bound of maximum allowable levels in filters expressed as ppt of TCDD TTE = 20 ppt

(b) Upper level drinker (90th quartile) consuming 6.5 cups of coffee per day 365 days of the year upper bound of maximum allowable levels in filters expressed as ppt of
TCDD TTE = 11 ppt.

The study used conservative assumptions in its risk assessment and calculation of maximum allowable dioxin toxic equivalence. It is stated this results in an overestimation of any potential theroretical risk to coffee consumers.

New Zealand's level of 10.4 ppt TTE is below both the upper and middle quartile level (see above) for the two exposure scenarios. This indicates a very low likelihood of exceeding these levels based on all estimates. However, the actual level of dioxin found in the coffee filters is high compared to both Sweden and U.S.A.

Tea bags

The American study (M.J.Sullivan and J.T. Stanford 1990)[3a] looked at the risk associated with dioxin exposure from tea brewed using tea bags containing bleached pulp. The levels of dioxin found in tea bag samples compared to NZ levels is given in Table 8.

Table 8 Dioxin levels in American and New Zealand tea bags

Country	2378-TCDD (ppt)	2378-TCDF (ppt)	TCDD TTE (ppt)
U.S.A	0.36 - 4.79	0.183 - 50.8	0.18 - 9.87
New Zealand	0.12	0.055	0.10

The U.S.A study tested 3 samples, NZ tested one composite sample. The dioxin levels found in the New Zealand tea bag sample are on the very low end of the scale compared to the U.S.A results.

Basing the calculation on the premise that tea would be drunk all year round, at 1.0 L per day for 55 years, and assessing the risk involved, the study calculated figures for maximum allowable daily dioxin intake and maximum daily tea consumption, Table 9.

Table 9 Maximum allowable dioxin levels and tea consumption based on American estimates

	Max.allowable dioxin (ppt TTE)	Max.daily tea consumption
Hot water brewed tea	230	150 Cups

*Calculation uses the FDA Dioxin Cancer Potency 1.74×10^4 $(mg/kg/day)^{-1}$ and assumes 10 ppt TCDD in the tea bag.

The NZ level was much lower than the highest TTE found in the American study of 9.87 ppt. As the exposure scenario is based on 10 ppt this indicates it would take a very high consumption of tea to reach the maximum level. This points to a low risk of dioxin exposure from tea bags. No New Zealander would be likely to approach the maximum allowable dioxin intake through tea consumption as estimated here.

It is difficult to make definitive conclusions due to the number of uncertainties in this study, not the least being there was only one sample tested.

MAFF (United Kingdom) did some work with coffee filters and tea bags and stated that "The available evidence suggests that in terms of contribution to total exposure, the intake of dioxins and furans from the use of tea-bags and coffee filters is likely to be extremely small." (MAFF Food Surveillance paper No. 31, p34 - Dioxins in Food).[5]

Butter paper and Waxed paper for separating meat.

It is very difficult to assess the significance of these levels of dioxins in these paper products. There is no information available on how much dioxin migrates into the food. Butter may also contain levels of dioxin from environmental sources.

CONCLUSIONS

The Department of Health concluded that there was no risk to health in consumption of milk from paperboard cartons.

The levels of dioxin in milk from paperboard cartons has markedly decreased since the March 1989 survey.

The sources of paperboard in New Zealand are contributing via milk only very low percentages of the Nordic Council tolerable weekly intake for dioxin.

Significant conclusions cannot be made from the results for food paper packaging, as only single composite samples were tested.

The New Zealand coffee filter sample had a higher TTE level than levels reported in literature for Swedish and U.S. samples.

This report indicates the intake of dioxins and furans from tea bags and coffee filters is very low.

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APPENDIX A1

Table A1 Monitoring results for levels of 2378[1], 1278[2], and TTE in standard milk sampled 1989/1990

Product	Milk fat (ppt)			Whole milk (ppt)		
	2378[1]	1278	TTE	2378	1278[2]	TTE
Blank[b]	< 0.13	< 0.17	0.25	<0.005	<0.006	0.009
Wellington 2L plastic	<0.2	<0.1	0.23	<0.006	<0.003	0.007
Northland 2L plastic	<0.1	<0.1	0.24	<0.002	<0.002	0.007
Wellington 1L Carton	0.88	0.51	0.68	0.027	0.016	0.021
Wellington 1L Carton	0.83	0.45	0.63	0.025	0.014	0.019
Northland 1L Carton	0.22	0.16	0.28	0.007	0.005	0.008
Northland 1L Carton	0.17	0.12	0.20	0.005	0.004	0.006
Auckland 1L Carton	5.1	3.3	1.59	0.16	0.110	0.051
Auckland 1L Carton	3.1	2.2	1.15	0.10	0.073	0.038
Auckland 2L Plastic	<0.4	<0.2	0.50	<0.01	<0.006	0.016
Hawkes Bay 2L Plastic	<0.3	<0.3	0.26	<0.01	<0.008	0.008
Hawkes Bay 1L Carton	0.22	0.13	0.30	0.0072	0.0043	0.010
Hawkes Bay 1L Carton	<0.2	<0.1	0.23	<0.007	<0.005	0.008
Christchurch 2L Plastic	<0.2	<0.2	0.41	<0.01	<0.007	0.013
Christchurch 1L Carton	<0.2	<0.2*	0.19	<0.005	<0.005*	0.006
Christchurch 1L Carton	<0.2	1.0*	0.33	<0.01	0.034*	0.010
Manawatu 2L Plastic	<0.1	<0.1*	0.27	<0.003	<0.003*	0.009
Manawatu 1L Carton	<0.1	0.18*	0.17	<0.004	0.006*	0.006
Manawatu 1L Carton	0.3	0.15*	0.24	0.01	0.005*	0.008

< Levels at less than limit of detection. Stated figure is limit of detection.
ppt Parts per trillion
b Blank figures are an average of three laboratory blank tests.
1 2378 = 2,3,7,8-tetrachlorodibenzofuran
2 1278 = 1,2,7,8-tetrachlorodibenzofuran
* For results with a * the number reported is the result for all non 2378 tetrafurans which include the 1278 TCDF isomer.

A2

Table A2 Comparison of mean dioxin levels for TCDF and TTE found in original survey, to those found in subsequent monitoring, in the different areas, for the two packaging types.

Packaging : Tetrapak		Milk Fat (ppt)			Whole milk (ppt)		
Area	Survey	2378	1278	TTE	2378	1278	TTE
Christchurch	March 1989	21.50	10.97	4.07	0.664	0.339	0.126
Christchurch	May 1991	<0.2	<0.2	0.3	<0.008	<0.006	0.009
Wellington	March 1989	15.03	8.84	3.43	0.433	0.255	0.099
Wellington	Nov 1989	0.86	0.48	0.66	0.026	0.015	0.020
Auckland	March 1989	44.18	21.48	6.25	0.929	0.451	0.131
Auckland	June 1990	4.10	2.75	1.37	0.13	0.087	0.045
Packaging : Purepak		Milk Fat (ppt)			Whole milk (ppt)		
Product	Survey	2378	1278	TTE	2378	1278	TTE
Tauranga	March 1989	1.93	1.09	1.26	0.0415	0.0235	0.027
Hawkes Bay	March 1989	1.20	0.69	0.77	0.0400	0.0255	0.0255
Wanganui	March 1989	11.89	6.75	2.56	0.3680	0.2085	0.0795
Greymouth	March 1989	4.87	2.67	0.91	0.1530	0.0840	0.0285
Northland	Nov 1989	0.20	0.14	0.24	0.0060	0.005	0.007
Hawkes Bay	May 1990	0.21	0.12	0.27	0.0071	0.0047	0.0089
Manawatu	April 1991	<0.20	0.17	0.21	<0.007	0.0058	0.0067

< = The mean value was calculated using levels that were less than the limit of detection.

In calculating the mean the limit of detection value was used but the < indicates the true average will be less then this value.

Note : Levels for March 1989 are from the original Dioxin survey, and are a mean of two composite samples of two cartons of the same brand. The other monitoring survey levels are an average of 2 samples.

SAMPLES: 1L Carton Packaged "Anchor Fresh" Standard Milk, Best before 11 June 1990, New Zealand Milk Corporation, Takanini, Auckland

DATE: 23 July 1990

Lab Reference	D85/1		D85/2	
Congeners	Milk Fat (ppt)	Whole Milk (ppt)	Milk Fat (ppt)	Whole Milk (ppt)
2378 TCDF	5.1	0.16	3.1	0.10
1278 TCDF	3.3	0.11	2.2	0.073
Non 2378 TCDF*	4.1	0.13	3.1	0.10
2378 TCDD	0.74	0.024	< 0.9	< 0.03
Non 2378 TCDD	0.54	0.017	< 0.9	< 0.03
12378 PeCDF	< 0.2	< 0.007	< 0.1	< 0.005
23478 PeCDF	0.21	0.0068	0.22	0.0071
Non 2378 PeCDF	0.68	0.022	0.31	0.010
12378 PeCDD	< 0.4	< 0.01	< 0.5	< 0.02
Non 2378 PeCDD	< 0.3	< 0.01	< 0.5	< 0.02
123478 HxCDF/ 123678 HxCDF	< 0.4	< 0.01	< 0.5	< 0.02
234678 HxCDF	< 0.2	< 0.008	< 0.2	< 0.008
123789 HxCDF	< 0.3	< 0.01	< 0.5	< 0.02
Non 2378 HxCDF	< 0.3	< 0.008	< 0.4	< 0.01
123478 HxCDD/ 123678 HxCDD	< 1	< 0.04	< 1	< 0.03
123789 HxCDD	< 0.5	< 0.01	< 0.8	< 0.02
Non 2378 HxCDD	< 0.5	< 0.01	< 0.8	< 0.02
1234678 HpCDF	< 0.2	< 0.005	< 0.3	< 0.009
1234789 HpCDF	< 0.1	< 0.003	< 0.2	< 0.007
Non 2378 HpCDF	< 0.1	< 0.004	< 0.2	< 0.007
1234678 HpCDD	< 0.5	< 0.02	0.48	0.016
Non 2378 HpCDD	0.30	0.010	< 0.4	< 0.01
OCDF	< 0.5	< 0.01	< 1	< 0.02
OCDD	1.3	0.043	1.4	0.046
Total toxic equivalents: (Nordic Basis)	1.59	0.051	1.15	0.038

* Excludes 1278-TCDF
< = Less than limit of detection (0.5 this value used to calculate TE)

SAMPLES: 1L Carton Packaged "Baymaid" Standard Milk, Best before 14 May 1990, Hawkes Bay Milk Corporation Ltd, Hastings

DATE: 23 July 1990

Lab Reference	D75/1-1		D75/1-2	
Congeners	Milk Fat (ppt)	Whole Milk (ppt)	Milk Fat (ppt)	Whole Milk (ppt)
2378 TCDF	0.22	0.0072	< 0.2	< 0.007
1278 TCDF	0.13	0.0043	< 0.1	< 0.005
Non 2378 TCDF*	0.069	0.0023	< 0.6	< 0.02
2378 TCDD	< 0.3	< 0.009	< 0.2	< 0.007
Non 2378 TCDD	1.0	0.034	1.0	0.033
12378 PeCDF	< 0.1	< 0.002	< 0.1	< 0.002
23478 PeCDF	< 0.2	< 0.005	< 0.2	< 0.006
Non 2378 PeCDF	0.47	0.016	0.45	0.015
12378 PeCDD	< 0.2	< 0.006	< 0.1	< 0.005
Non 2378 PeCDD	0.21	0.0070	< 0.2	< 0.008
123478 HxCDF/ 123678 HxCDF	< 0.2	< 0.01	< 0.2	< 0.01
234678 HxCDF	< 0.1	< 0.003	< 0.1	< 0.002
123789 HxCDF	< 0.1	< 0.004	< 0.1	< 0.003
Non 2378 HxCDF	< 0.1	< 0.005	< 0.1	< 0.005
123478 HxCDD/ 123678 HxCDD	< 0.4	< 0.01	< 0.4	< 0.01
123789 HxCDD	< 0.2	< 0.005	< 0.1	< 0.004
Non 2378 HxCDD	< 0.3	< 0.01	< 0.3	< 0.01
1234678 HpCDF	< 0.1	< 0.005	< 0.2	< 0.005
1234789 HpCDF	< 0.1	< 0.002	< 0.1	< 0.003
Non 2378 HpCDF	< 0.1	< 0.005	< 0.2	< 0.008
1234678 HpCDD	< 0.4	< 0.01	< 0.5	< 0.02
Non 2378 HpCDD	< 0.7	< 0.02	< 0.6	< 0.02
OCDF	< 1	< 0.03	< 1	< 0.03
OCDD	1.6	0.052	1.4	0.047
Total toxic equivalents: (Nordic Basis)	0.30	0.0098	0.23	0.0080

* Excludes 1278-TCDF

< = Less than limit of detection (0.5 this value used to calculate TE)

SAMPLES: 1) 2L Plastic Packaged "Anchor Fresh" Standard Milk, Best before 12 June 1990, New Zealand Milk Corporation, Takanini, Auckland
2) 2L Plastic Packaged "Baymaid" Standard Milk, Best before 14 May 1990, Hawkes Bay Milk Corporation Ltd, Hastings

DATE: 23 July 1990

Lab Reference	1) D85/3		2) D75/2	
Congeners	Milk Fat (ppt)	Whole Milk (ppt)	Milk Fat (ppt)	Whole Milk (ppt)
2378 TCDF	< 0.4	< 0.01	< 0.3	< 0.01
1278 TCDF	< 0.2	< 0.006	< 0.3	< 0.008
Non 2378 TCDF*	< 0.2	< 0.006	< 0.3	< 0.008
2378 TCDD	< 0.2	< 0.007	< 0.2	< 0.006
Non 2378 TCDD	< 0.8	< 0.02	0.87	0.028
12378 PeCDF	< 0.1	< 0.004	< 0.1	< 0.003
23478 PeCDF	< 0.3	< 0.01	< 0.1	< 0.004
Non 2378 PeCDF	< 0.3	< 0.01	< 0.2	< 0.007
12378 PeCDD	< 0.4	< 0.01	< 0.2	< 0.005
Non 2378 PeCDD	< 0.3	< 0.01	< 0.3	< 0.01
123478 HxCDF/ 123678 HxCDF	< 0.6	< 0.02	< 0.3	< 0.01
234678 HxCDF	< 0.3	< 0.01	< 0.2	< 0.006
123789 HxCDF	< 0.4	< 0.01	< 0.2	< 0.006
Non 2378 HxCDF	< 0.4	< 0.01	< 0.2	< 0.007
123478 HxCDD/ 123678 HxCDD	< 1	< 0.04	< 0.4	< 0.01
123789 HxCDD	< 0.7	< 0.02	< 0.3	< 0.009
Non 2378 HxCDD	< 0.7	< 0.02	< 0.4	< 0.01
1234678 HpCDF	< 0.2	< 0.006	< 0.1	< 0.005
1234789 HpCDF	< 0.2	< 0.006	< 0.1	< 0.005
Non 2378 HpCDF	< 0.1	< 0.004	< 0.1	< 0.005
1234678 HpCDD	0.90	0.029	< 0.5	< 0.01
Non 2378 HpCDD	< 0.7	< 0.02	< 0.4	< 0.01
OCDF	< 0.7	< 0.02	< 1	< 0.02
OCDD	3.4	0.11	1.3	0.041
Total toxic equivalents: (Nordic Basis)	0.50	0.016	0.26	0.0083

* Excludes 1278-TCDF
< = Less than limit of detection (0.5 this value used to calculate TE)

SAMPLES: 1L Carton Packaged "Northland Fresh" Standard Milk, Best before 13 November 1989, Northland Dairy Products Ltd, Whangarei

DATE: 25 June 1990

Lab Reference	D58/1(3)		D58/1(4)	
Congeners	Milk Fat (ppt)	Whole Milk (ppt)	Milk Fat (ppt)	Whole Milk (ppt)
2378 TCDF	0.22	0.007	0.17	0.005
1278 TCDF	0.16	0.005	0.12	0.004
Non 2378 TCDF*	< 0.1	< 0.003	< 0.4	< 0.012
2378 TCDD	< 0.2	< 0.005	< 0.1	< 0.004
Non 2378 TCDD	< 0.5	< 0.016	< 0.8	< 0.024
12378 PeCDF	< 0.1	< 0.003	< 0.1	< 0.002
23478 PeCDF	< 0.1	< 0.002	< 0.1	< 0.002
Non 2378 PeCDF	< 0.3	< 0.008	< 0.3	< 0.010
12378 PeCDD	< 0.1	< 0.004	< 0.1	< 0.003
Non 2378 PeCDD	< 0.1	< 0.004	< 0.3	< 0.009
123478 HxCDF/ 123678 HxCDF	< 0.5	< 0.015	< 0.4	< 0.011
234678 HxCDF	< 1	< 0.029	< 0.7	< 0.021
123789 HxCDF	< 0.2	< 0.006	< 0.1	< 0.003
Non 2378 HxCDF	< 0.7	< 0.020	< 0.4	< 0.011
123478 HxCDD/ 123678 HxCDD	< 0.3	< 0.008	< 0.2	< 0.005
123789 HxCDD	< 0.2	< 0.006	< 0.1	< 0.003
Non 2378 HxCDD	< 0.7	< 0.022	< 0.8	< 0.024
1234678 HpCDF	< 0.1	< 0.004	< 0.03	< 0.001
1234789 HpCDF	< 0.1	< 0.004	< 0.03	< 0.001
Non 2378 HpCDF	< 0.1	< 0.004	< 0.03	< 0.001
1234678 HpCDD	< 0.3	< 0.007	< 0.3	< 0.008
Non 2378 HpCDD	< 0.3	< 0.007	< 0.1	< 0.004
OCDF	< 1	< 0.026	< 1	< 0.022
OCDD	< 1	< 0.038	< 1	< 0.035
Total toxic equivalents: (Nordic Basis)	0.28	0.008	0.20	0.006

* Excludes 1278-TCDF
< = Less than limit of detection (0.5 this value used to calculate TE)

SAMPLES: 1L Carton Packaged "Spring Time" Standard Milk, Best before 10 November 1989, Capital Dairy Products Ltd, Wellington

DATE: 25 June 1990

Lab Reference	D56/1(3)		D56/1(4)	
Congeners	Milk Fat (ppt)	Whole Milk (ppt)	Milk Fat (ppt)	Whole Milk (ppt)
2378 TCDF	0.88	0.027	0.83	0.025
1278 TCDF	0.51	0.016	0.45	0.014
Non 2378 TCDF*	< 0.05	< 0.002	< 0.1	< 0.004
2378 TCDD	0.26	0.008	0.30	0.009
Non 2378 TCDD	< 0.2	< 0.005	< 0.4	< 0.012
12378 PeCDF	< 0.05	< 0.001	< 0.1	< 0.003
23478 PeCDF	0.38	0.012	< 0.1	< 0.003
Non 2378 PeCDF	0.46	0.014	0.60	0.018
12378 PeCDD	< 0.2	< 0.006	< 0.2	< 0.005
Non 2378 PeCDD	< 0.3	< 0.008	< 0.3	< 0.010
123478 HxCDF/ 123678 HxCDF	< 0.5	< 0.015	< 0.9	< 0.027
234678 HxCDF	< 0.9	< 0.028	< 0.2	< 0.052
123789 HxCDF	< 0.1	< 0.003	< 0.3	< 0.008
Non 2378 HxCDF	< 0.6	< 0.019	< 0.8	< 0.025
123478 HxCDD/ 123678 HxCDD	< 0.1	< 0.004	< 0.3	< 0.009
123789 HxCDD	< 0.2	< 0.006	< 0.2	< 0.007
Non 2378 HxCDD	< 0.3	< 0.010	< 2	< 0.051
1234678 HpCDF	< 0.1	< 0.002	< 0.2	< 0.005
1234789 HpCDF	< 0.1	< 0.002	< 0.2	< 0.005
Non 2378 HpCDF	< 0.1	< 0.002	< 0.2	< 0.005
1234678 HpCDD	< 0.1	< 0.004	< 0.3	< 0.009
Non 2378 HpCDD	< 0.1	< 0.004	< 0.3	< 0.009
OCDF	< 1	< 0.026	< 1	< 0.029
OCDD	1.7	0.051	< 1	< 0.029
Total toxic equivalents: (Nordic Basis)	0.68	0.021	0.63	0.019

* Excludes 1278-TCDF
< = Less than limit of detection (0.5 this value used to calculate TE)

SAMPLES: 1) 2L Plastic Packaged "Northland Fresh" Standard Milk, Best before 13 November 1989, Northland Dairy Products Ltd, Whangarei

2) 2L Plastic Packaged "Quality Farm" Standard Milk, Best before 12 November 1989, Capital Dairy Products Ltd, Wellington

DATE: 25 June 1990

Lab Reference	1) D58/2		2) D56/2	
Congeners	Milk Fat (ppt)	Whole Milk (ppt)	Milk Fat (ppt)	Whole Milk (ppt)
2378 TCDF	< 0.1	< 0.002	< 0.2	< 0.006
1278 TCDF	< 0.1	< 0.002	< 0.1	< 0.003
Non 2378 TCDF*	< 0.1	< 0.003	< 0.1	< 0.003
2378 TCDD	< 0.2	< 0.006	< 0.2	< 0.007
Non 2378 TCDD	< 0.7	< 0.023	< 0.4	< 0.014
12378 PeCDF	< 0.1	< 0.003	< 0.1	< 0.002
23478 PeCDF	< 0.1	< 0.003	< 0.2	< 0.007
Non 2378 PeCDF	< 0.3	< 0.008	< 0.2	< 0.007
12378 PeCDD	< 0.1	< 0.004	< 0.1	< 0.003
Non 2378 PeCDD	< 0.2	< 0.008	< 0.2	< 0.006
123478 HxCDF/ 123678 HxCDF	< 0.4	< 0.014	< 0.1	< 0.003
234678 HxCDF	< 0.8	< 0.026	< 0.2	< 0.005
123789 HxCDF	< 0.2	< 0.005	< 0.1	< 0.005
Non 2378 HxCDF	< 0.5	< 0.015	< 0.5	< 0.014
123478 HxCDD/ 123678 HxCDD	< 0.2	< 0.006	< 0.2	< 0.005
123789 HxCDD	< 0.1	< 0.005	< 0.1	< 0.004
Non 2378 HxCDD	< 0.5	< 0.016	< 0.5	< 0.014
1234678 HpCDF	< 0.1	< 0.002	< 0.1	< 0.003
1234789 HpCDF	< 0.1	< 0.002	< 0.1	< 0.003
Non 2378 HpCDF	< 0.1	< 0.002	< 0.1	< 0.003
1234678 HpCDD	< 0.3	< 0.009	< 0.3	< 0.011
Non 2378 HpCDD	< 0.1	< 0.005	< 0.2	< 0.005
OCDF	< 1	< 0.039	< 1	< 0.032
OCDD	1	< 0.038	< 2	< 0.052
Total toxic equivalents: (Nordic Basis)	0.24	0.007	0.23	0.007

* Excludes 1278-TCDF

< = Less than limit of detection (0.5 this value used to calculate TE)

SAMPLES: 1L Carton Packaged "Tararua" Standard Homogenised Milk, Pure Pak; Best Before 20 April 1992, Manawatu.

DATE: 24 April 1992

Lab Reference		D178/1,2		D178/3,4	
Congeners		Milk fat (ppt)	Whole Milk (ppt)	Milk Fat (ppt)	Whole Milk (ppt)
2378 TeF		0.3	0.01	< 0.1	< 0.004
NON 2378 TeF		0.15	0.0052	0.18	0.0064
2378 TeD	<	0.14	< 0.0049	< 0.1	< 0.004
NON 2378 TeD		0.82	0.029	0.71	0.025
12378 PeF	<	0.09	< 0.003	< 0.08	< 0.003
23478 PeF	<	0.1	< 0.004	< 0.07	< 0.003
NON 2378 PeF	<	0.2	< 0.006	< 0.2	< 0.006
12378 PeD	<	0.2	< 0.007	< 0.1	< 0.004
NON 2378 PeD	<	0.3	< 0.009	< 0.2	< 0.006
123478 HxF	<	0.1	< 0.005	< 0.1	< 0.005
123678 HxF	<	0.09	< 0.003	< 0.1	< 0.003
234678 HxF	<	0.1	< 0.003	< 0.1	< 0.003
123789 HxF	<	0.2	< 0.007	< 0.2	< 0.007
NON 2378 HxF	<	0.1	< 0.005	< 0.1	< 0.005
123478 HxD	<	0.2	< 0.007	< 0.2	< 0.008
123678 HxD	<	0.2	< 0.006	< 0.2	< 0.006
123789 HxD	<	0.2	< 0.006	< 0.2	< 0.006
NON 2378 HxD	<	0.3	< 0.009	< 0.3	< 0.009
1234678 HpF	<	0.4	< 0.01	< 0.5	< 0.02
1234789 HpF	<	0.2	< 0.007	< 0.2	< 0.008
NON 2378 HpF	<	0.3	< 0.01	< 0.2	< 0.008
1234678 HpD	<	0.9	< 0.03	< 0.7	< 0.02
NON 2378 HpD	<	0.6	< 0.02	< 0.7	< 0.02
OCDF	<	1	< 0.05	< 2	< 0.06
OCDD	<	5	< 0.2	< 6	< 0.2
Total Toxic Equivalents: (NATO Basis)		0.24	0.0076	0.17	0.0058

* Excludes 1278-TCDF

< = Less than limit of detection (0.5 this value used to calculate TE)

SAMPLES: 1L Carton Packaged "Meadow Fresh" Standard Homogenised Milk, Tetra Pak; Best Before 5 May 1991, Christchurch.

DATE: 24 April 1992

Lab Reference	D184/1,2		D184/3,4	
Congeners	Milk fat (ppt)	Whole Milk (ppt)	Milk Fat (ppt)	Whole Milk (ppt)
2378 TeF	< 0.2	< 0.01	< 0.2	< 0.005
NON 2378 TeF	1.0	0.034	< 0.2	< 0.005
2378 TeD	< 0.2	< 0.005	< 0.1	< 0.004
NON 2378 TeD	< 0.3	< 0.01	< 0.3	< 0.008
12378 PeF	< 0.1	< 0.004	< 0.07	< 0.002
23478 PeF	< 0.2	< 0.005	< 0.1	< 0.004
NON 2378 PeF	< 0.3	< 0.01	< 0.1	< 0.004
12378 PeD	< 0.2	< 0.006	< 0.1	< 0.003
NON 2378 PeD	< 0.3	< 0.008	< 0.2	< 0.007
123478 HxF	< 0.3	< 0.009	< 0.2	< 0.005
123678 HxF	< 0.2	< 0.007	< 0.1	< 0.004
234678 HxF	< 0.2	< 0.007	< 0.1	< 0.003
123789 HxF	< 0.5	< 0.02	< 0.2	< 0.006
NON 2378 HxF	< 0.3	< 0.009	< 0.2	< 0.005
123478 HxD	< 0.4	< 0.01	< 0.2	< 0.006
123678 HxD	< 0.4	< 0.01	< 0.1	< 0.004
123789 HxD	< 0.4	< 0.01	< 0.1	< 0.004
NON 2378 HxD	< 0.6	< 0.02	< 0.3	< 0.009
1234678 HpF	< 1	< 0.03	< 0.3	< 0.01
1234789 HpF	< 0.5	< 0.02	< 0.07	< 0.002
NON 2378 HpF	< 0.5	< 0.02	< 0.1	< 0.004
1234678 HpD	< 1	< 0.05	< 1	< 0.03
NON 2378 HpD	< 1	< 0.05	< 0.5	< 0.02
OCDF	< 3	< 0.1	< 0.5	< 0.02
OCDD	12.6	0.416	< 4	< 0.1
Total Toxic Equivalents: (NATO Basis)	0.33	0.010	0.19	0.0058

* Excludes 1278-TCDF

< = Less than limit of detection (0.5 this value used to calculate TE)

DIOXIN LEVELS IN FOOD PAPER PACKAGING PRODUCTS

DATE: 4 February 1991

Reference	Level (ppt) D65/1 Tea Bags	D65/2 Coffee Filters	D65/3 Butter Paper	D65/4 Waxpaper
2378 TCDF	0.12	28.4	3.1	11.3
1278 TCDF	0.055	10.6	1.2	6.2
Non 2378 TCDF*	< 0.05	11.3	1.2	3.6
2378 TCDD	< 0.1	7.1	0.26	0.53
Non 2378 TCDD	< 0.1	0.43	< 0.06	0.37
12378 PeCDF	< 0.06	1.0	< 0.3	0.16
23478 PeCDF	< 0.07	0.61	< 0.2	0.084
Non 2378 PeCDF	< 0.2	1.7	< 0.5	0.45
12378 PeCDD	< 0.06	0.42	< 0.2	1.6
Non 2378 PeCDD	< 0.2	0.74	< 0.6	0.24
123478 HxCDF/	< 0.09	0.28	< 0.3	< 0.1
123678 HxCDF	< 0.1	0.20	< 1	< 0.5
234678 HxCDF	< 0.07.	0.12	< 0.1	< 0.1
123789 HxCDF	< 0.1	0.11	< 0.2	< 0.2
Non 2378 HxCDF	< 0.09.	0.38	< 0.3	< 0.2
123478 HxCDD/	< 0.09	0.23	< 0.8	< 0.3
123678 HxCDD	< 0.2	0.30	< 0.4	3.4
123789 HxCDD	< 0.1	0.40	< 0.2	1.4
Non 2378 HxCDD	0.30	1.7	0.79	16.1
1234678 HpCDF	0.17	0.36	< 0.7	< 0.1
1234789 HpCDF	< 0.06	< 0.04	< 0.4	< 0.06
Non 2378 HpCDF	0.26	0.11	< 0.4	0.15
1234678 HpCDD	2.2	3.4	1.4	9.6
Non 2378 HpCDD	3.0	3.5	1.1	10.3
OCDF	1.6	0.51	< 4	1.3
OCDD	115.8	9.6	18.7	56.3
Total toxic equivalents: (NATO Basis)	0.27	10.7	0.87	3.2

< = Less than limit of detection (0.5 this value used calculating TE)

Analytical Method

Milk

All samples were stored at 4°C until analysis.

After spiking with $^{13}C_{12}$ labelled internal standards the sample was extracted with organic solvents and purified with chemical treatment and solid phase chromatographic techniques. Measurement was performed using high resolution capillary chromatography and high resolution electron impact mass spectrometry.

Quantification of native dioxins and furans by GCMS was performed on a VG 70-250OS data system and a Hewlett Packard 5890 gas chromatograph.

Quality assurance is carried out to ensure:
(a) Laboratory contamination is avoided.
(b) The sample cam be accurately quantified, and
(c) The results are reproducible.

For more details on analytical method see "A survey of some New Zealand retail milk supplies for the presence of dioxin March - April 1989" (DSIR - Department of Health 1989).

Food Paper packaging

After spiking with $^{13}C_{12}$ labelled internal standards the sample was extracted with organic solvents and purified with chemical treatment and solid phase chromatographic techniques. Measurement was performed using high resolution capillary chromatography and high resolution electron impact mass spectrometry.

Sample details

Tea bags - A 14.7g sample was used (tea bags minus tea) made up of 25 each from 4 packets of 100 bleached tea bags.

Coffee filters - A 32.6g sample was used made up of 5 filters from each of 5 packets of 40 (size 1x6). These were cut in half and 25 halves were used.

Butter paper - A 16.3g sample made up of 10 Wrappers from 500g butter.

Meat paper - A sample of 15.6g made up of 13 out of the 34 wrappers from a 2kg meat patty pack.