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DIOXINS AND DIOXIN-LIKE PCBs IN FARMED & WILD FISH AND SHELLFISH

Summary

In order to allow a robust dietary intake of dioxins and PCBs from fish to be estimated, composite samples of 47 species of farmed and wild fish and shellfish consumed in the UK were analysed for dioxins and PCBs. Individual samples were also tested to establish concentration ranges in five species. Dioxins and PCBs were detected at low concentrations in all samples, with slightly higher concentrations generally being found in oily than in non-oily fish. Where comparisons are possible, concentrations are generally lower than found in previous surveys. Only one individual sample from the 158 analysed exceeded the regulatory limit for dioxins in fish. Based on the results of this survey, the Agency's advice on the consumption of oily fish remains unchanged.

Key Facts

- Dioxins and PCBs were analysed in 47 composite samples made up from 30 or 60 individual samples of single species of fish and shellfish, and additionally in up to 30 individual samples each of mackerel, herring, wild and farmed salmon and farmed trout.
- Dioxins and PCBs were found at low concentrations in all of the samples analysed. Total TEQ concentrations were in the range 0.02 - 9.5 ng WHO-TEQ/kg fresh weight, with the exception of one sample of mackerel that contained a level of 28 ng WHO-TEQ/kg fresh weight.
- A new limit for the combination of dioxins plus dioxin-like PCBs and a new action level for dioxin-like PCBs in fish have been agreed since the samples were obtained. One herring contained a total TEQ concentration above the new limit for dioxins plus dioxin-like PCBs, whilst one herring, one mackerel and the composite sardines/pilchards samples contained concentrations of dioxin-like PCBs that were above the new EC action level.

- There were no significant differences between the levels of dioxins in wild and farmed salmon, but the levels of dioxin-like PCBs, and therefore of total TEQs, were higher in the latter. Organic salmon and trout had similar dioxin and dioxin-like PCB concentrations to the conventionally farmed fish.
- Where a comparison was possible, concentrations were generally found to have fallen since previous surveys.
- Based on the results of this survey, the Agency's advice on the consumption of oily fish remains unchanged. Consumers should eat at least two portions of fish per week, one of which should be oily. Girls and women who may have a baby one day are advised to limit their consumption of oily fish to two portions per week whilst all other consumers are advised to limit their consumption of oily fish to four portions per week.
- As some non-oily fish species contain higher levels of dioxins and PCBs than others, people who eat a lot of fish should vary the species of fish they eat.

Background

Background information on dioxins and PCBs can be found in the Food Standards Agency's Food Survey Information Sheet No 38/03 which also contains data for dioxins and PCBs in average diets and estimates of intakes.¹

The Ministry of Agriculture, Fisheries and Food carried out surveys for dioxins and PCBs in marine fish, salmon and farmed trout during 1994-96, and in eels from commercial fisheries in 1992. The results were published as Food Surveillance Information Sheets No 184, 145 and 105 respectively.²⁻⁴

Data from the analysis of the 2003/4 wild and farmed fish samples for a range of brominated organic compounds are published separately in information sheet FSIS 04/06.

Methodology

Fish species

The sampling plan for the 2003/04 survey, covering most of the fish and shellfish available on the UK market, was produced by the University of Bristol.⁵ A total of 24 species of fresh wild fish, seven of farmed fish, seven of fresh shellfish and ten of canned or processed fish and shellfish were sampled (Table 1). Processed fish and fish products are being covered in more detail in a separate survey that will be completed in 2006.

Sampling

Samples were obtained by Direct Laboratories, where possible from retail outlets throughout the UK, otherwise from specialised suppliers. The target was 60 samples per species, i.e. a total of over 2,800 samples. For the larger species, steaks or fillets were normally obtained, otherwise whole fish were purchased. In order to take account of seasonal variations, samples were purchased regularly throughout the sampling period, except for herring, mackerel and sprats for which the bulk of catches is taken during limited seasons. For canned fish, samples were obtained in brine rather than oil (not possible for anchovy). Further details of the sampling can be found in the sampling contractor's final report.⁵

Preparation

The edible portions of each sample (Table 1) were homogenised individually and portions of each homogenate were then combined and further homogenised into a single composite sample for each species. Final homogenates comprised 30 samples per species for those also being tested individually or 60 samples per species for those analysed only in bulk. The large numbers of samples were required to ensure that the average concentrations required for estimating dietary intakes would be statistically robust. In the case of wild and farmed salmon, farmed trout, herring and mackerel, 30 of the samples purchased were analysed individually (28 in the case of farmed trout), and the remaining 30 samples of each of these five species were analysed as composites. A small number of organic salmon and trout were analysed as individual samples. Brand names are not available where composite samples were analysed but, where available, are provided in Appendix 2 for those species for which individual samples were analysed.⁶

Analysis

Analysis of the 17 dioxins and furan congeners and 12 dioxin-like PCBs assigned toxic equivalency factors by the World Health Organization⁷ was conducted by the Central Science Laboratory (CSL) using high resolution gas chromatography coupled with high or low resolution mass spectrometry.⁸ Full details of the analytical methodology can be found in the analytical contractor's final report for the survey.⁹ All results met published analytical quality assurance criteria.¹⁰

Results

The concentrations of dioxins and dioxin-like PCBs (ng WHO-TEQ/kg fresh weight) in the composite fish and shellfish samples are summarised in Table 2 and a comparison with previous data in Tables 3 and 4. Concentrations found in shellfish samples from 1997-98 and 2001 (previously unreported) are presented in Tables 6a and 6b in Appendix 1. All results refer to the edible portions of the fish. Concentrations in herring, mackerel, eels, crab, mussels, oysters and scallops were considerably reduced compared with previous data; other values were very similar or slightly lower. Full details can be found in the contractor's final reports for the work,^{9,11,12} including the measurement uncertainties for the 2003-04 samples only. The concentrations found are generally similar to those reported in other countries.¹³⁻³⁶ The contractor's reports also contain details of the non-dioxin-like PCBs that were measured at the same time.

With the exception of one mackerel, the concentrations of dioxins found in the 2003-04 samples were within the EU Maximum Limit and Action Level for dioxins alone in fish and fishery products of 4 and 3 ng WHO-TEQ/kg fresh weight respectively which applied at the time of sampling.^{37,38} Since then a new limit of 8 ng WHO-TEQ/kg fresh weight for the combination of dioxins and dioxin-like PCBs in fish and fishery products has been agreed. Only one individual herring and one mackerel would have exceeded the new limit.³⁹

Statistical analysis

A statistical analysis of the results indicates that, whilst there was no significant difference in the dioxins levels in salmon whether wild (0.03-1.1 ng WHO-TEQ/kg, mean 0.5) or farmed (0.3-0.9, mean 0.6), the PCB levels were higher in farmed (1.0-2.6, mean 1.8, compared with 0.07-2.8, mean 0.9 for wild, $p < 0.001$). In terms of total TEQ, the average level in farmed salmon was 2.4 ng/kg, compared with 1.4 ng/kg for wild. The difference is 1 ng/kg with a 95% confidence interval of 0.7-1.3, indicating that the difference is statistically significant, although it is unlikely to have a major effect on exposure to dioxins and dioxin-like PCBs. The results are presented graphically in Figure 1.

The concentrations of dioxins plus dioxin-like PCBs in the organic salmon and trout samples were similar to those found in conventionally farmed fish, although there were insufficient organic samples to make a valid statistical comparison.

For all species where comparisons with previous results are possible, concentrations appear to be similar or lower. The fall for farmed salmon was small and for some white fish species, including cod, which already contained very low levels in flesh, there was effectively no change.

The results from the composite samples show these to be a good representation of the range of results seen for the individual analyses. A statistical analysis of the results for individual and composite samples also suggests that, for all species, no sample would have exceeded, at the 95% confidence interval, either the dioxins limit which applied at the time³⁷ or the total TEQ limit for dioxins plus dioxin-like PCBs which has subsequently been agreed.³⁹

Interpretation

Dietary intakes of dioxins and dioxin-like PCBs from the various fish species were estimated from the concentrations found in the composite samples from 2003-04, assuming consumption of one and two portions per week. Dietary intakes have not been estimated from the results of the samples tested individually as, over the long term, consumers would be eating fish with a range of concentrations. For these species, intakes were therefore estimated from the weighted averages of the concentrations in the composite and individual samples. Portion sizes of 140 g were assumed for most fresh fish, 70 g for fresh sardines/pilchards, whitebait, rollmops, most canned fish and all shellfish species, and 30 g for fish paste, canned anchovy and surimi. Estimated dietary intakes are presented in Table 6. The intake from non-fish part of the diet was estimated from the results of the 2001 Total Diet Study.¹

The estimated dietary intakes of dioxins and dioxin-like PCBs by adults from single weekly portions of oily fish would be in the range 0.01 to 1.4 pg WHO-TEQ/kg bodyweight per day.

Health considerations

There are nutritional benefits from consuming all types of fish. Oily fish are a rich source of long chain polyunsaturated fatty acids (PUFAs), which have been shown to help protect against coronary heart disease. These fatty acids are also important for the development of the central nervous system in the foetus and evidence suggests that there may also be beneficial effects of oily fish consumption during pregnancy and lactation on foetal development.

In 2001, the COT recommended a Tolerable Daily Intake (TDI) for dioxins and dioxin-like PCBs of 2 pg WHO-TEQ/kg bodyweight/day.⁴⁰ The results of the current survey show that consumers eating single weekly portions each of most oily fish together with white fish would not exceed this TDI when the rest of the diet is taken into account. The one exception is for sprats, when the TDI would be exceeded slightly. Consumption of two weekly portions of herring, mackerel, farmed salmon, wild sea bass, dogfish, Greenland turbot, fresh sardines/pilchards, whitebait, sprats or farmed halibut could result in slight exceedence of the TDI. However, the potential adverse effects of exposure to dioxins are

long-term and therefore occasional exceedences of the TDI are not a cause for concern as they are likely to be offset by occasions when exposure is below the TDI.

In 2004, the COT and the Scientific Advisory Committee on Nutrition (SACN) reviewed the nutritional benefits and risk from contaminants of fish consumption.⁴¹ As a result of this review, the Agency reaffirmed its existing advice that consumers of all ages should eat at least two portions of fish per week, one of which should be oily, as part of a balanced diet.⁴² Furthermore, it was noted that the TDI is set at a level to provide protection to the developing foetus by minimising exposure for girls and women of reproductive age. Any risk to other consumer groups is correspondingly lower. On this basis, the Agency also issued new advice on maximum levels of fish consumption:⁴³

- Women of reproductive age and girls should aim to consume one to two portions of oily fish a week in order to maintain consumption of dioxins and dioxin-like PCBs below the TDI of 2 pg WHO-TEQ/kg bodyweight per day.
- Women past reproductive age, boys and men should aim to consume one to four portions of oily fish a week in order to maintain consumption of dioxins and dioxin-like PCBs below the guideline value of 8 pg WHO-TEQ/kg bodyweight per day.

This advice remains unchanged. However, as some non-oily species, i.e. sea bass, sea bream, turbot, halibut, dogfish (huss) and crab, contain similar levels of dioxins and PCBs to oily fish, people who eat a lot of fish every week are advised to vary the type of fish they eat, eating less of these species. They should also be aware that eating a combination of oily fish and some of the other species such as turbot and sea bream could result in them exceeding the maximum recommended consumption amounts for these fish.

Conclusion

In total 47 species of farmed and wild fish and shellfish consumed in the UK have been tested for dioxins and PCBs. Individual samples of mackerel, herring, farmed trout and farmed and wild salmon were also tested to establish variability. Dioxins and PCBs were detectable in all samples, with higher concentrations generally being found in oily fish. Where comparisons are possible, concentrations are generally lower than found in previous surveys. Of 158 samples analysed individually, only one exceeded the regulatory limit for dioxins in fish.

Summary of Units

ppb	parts per billion, equivalent to one microgram per kilogram (kg)
kg	a kilogram (kg) is one thousand grams (g)
µg	microgram, one millionth of a gram
ng	a nanogram is one thousand millionth of a gram
pg/kg bw/day	picograms per kilogram of bodyweight per day; equivalent to parts per thousand million million by weight.
pg	a picogram is one million millionth of a gram

Note on nomenclature

'Dioxins' means the sum of polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs).

In the data tables, where results are reported as 'upper bound' the calculations have assumed that any dioxins or dioxin-like PCBs that were present below the analytical limit of determination were actually present at this level. 'Lower bound' calculations assume figures below the limit of determination to be zero. Although upper bound results may lead to an overestimate, the very high sensitivity of the analytical method used means that, in this case, the differences between upper and lower bound results are negligible.

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Table 1: Fish and shellfish analysed as composite samples

Fish/shellfish species		No of fish in composite	Material for analysis
English name	Latin name		
<i>Wild fish:</i>			
Atlantic salmon	<i>Salmo salar</i>	30 +30 individual	Muscle minus skin minus bone
Herring	<i>Clupea harengus</i>	30 +30 individual	Muscle plus skin minus bone
Mackerel	<i>Scomber scombrus</i>	30 +30 individual	Muscle minus skin minus bone
Cod	<i>Gaddus morhua</i>	60	Muscle minus skin minus bone
Plaice	<i>Pleuronectus platessa</i>	60	Muscle minus skin minus bone
Haddock	<i>Melanogammus aeglefinus</i>	60	Muscle minus skin minus bone
Turbot (UK)	<i>Psetta maxima</i>	60	Muscle minus skin minus bone
Sea Bass	<i>Dicentrarchus labrax</i>	60	Muscle minus skin minus bone
Shark	<i>Various spp</i>	60	Muscle minus skin minus bone
Swordfish	<i>Xiphias gladius and Istrophous spp</i>	60	Muscle minus skin minus bone
Tuna	<i>Thunnus & Katsuwonus spp</i>	60	Muscle minus skin minus bone
Dogfish	<i>Squalus spp</i>	60	Muscle minus skin minus bone
Turbot (Greenland)	<i>Reinhardtius hippoglossoides</i>	60	Muscle minus skin minus bone
Sprat	<i>Sprattus sprattus</i>	60	As purchased minus head
Whitebait	<i>Juveniles of assorted species</i>	60	Whole fish + gut
Halibut	<i>Hippoglossus hippoglossus</i>	60	Muscle minus skin minus bone
Eel	<i>Anguilla spp</i>	60	Muscle minus skin minus bone
Sardine/Pilchard	<i>Sardina pilchardus</i>	60	Muscle minus skin minus bone
Alaskan salmon	<i>Oncorhynchus spp</i>	60	Muscle minus skin minus bone
Lemon Sole	<i>Microstomus Kitt</i>	60	Muscle minus skin minus bone
Coley	<i>Pallohius virens</i>	60	Muscle minus skin minus bone
Hake	<i>Merluccius merluccius</i>	60	Muscle minus skin minus bone
Whiting	<i>Merlangius merlangus</i>	60	Muscle minus skin minus bone
Red snapper	<i>Lutjanus spp</i>	60	Muscle minus skin minus bone
<i>Shellfish:</i>			
Crab (brown/white)	<i>Cancer pagurus</i>	60	Contents of displayed carapace
Scampi	<i>Nephrops norvegicus</i>	60	Flesh from tail
Prawns warm	<i>Penaeid spp</i>	60	Flesh from tail
Prawns cold	<i>Pandalid spp</i>	60	Flesh from tail
Mussels	<i>Mytilus edulis</i>	60	Drained contents of shell
Scallops	<i>Pecten & Chlamys spp</i>	60	Adductor muscle + roe
Oysters	<i>Ostrea edulis and Crassostrea gigus</i>	60	Drained contents of shell

Table 1 (cont.): Fish and shellfish analysed as composite samples

Fish/shellfish species		No of fish in composite	Material for analysis
English name	Latin name		
<i>Canned and processed fish:</i>			
Crab (white)*		60	Drained contents of can
Surimi		60	Stick
Salmon*		60	Drained contents of can
Mackerel*		60	Drained contents of can
Herring (Rollmops)		60	Drained - stick - onion
Sardine*		60	Drained contents of can
Pilchard*		60	Drained contents of can
Tuna*		60	Drained contents of can
Anchovy		60	Drained contents of can
Fish paste**		60	Contents of pot
<i>Farmed fish:</i>			
Atlantic salmon	<i>Salmo salar</i>	30 +30 individual	Muscle minus skin minus bone
Organic salmon (farmed)	<i>Salmo salar</i>	No composite 4 individual	Muscle minus skin minus bone
Rainbow trout (farmed)	<i>Oncorhynchus mykiss</i>	30 + 28 individual	Muscle minus skin minus bone
Organic rainbow trout (farmed)	<i>Oncorhynchus mykiss</i>	No composite 6 individual	Muscle minus skin minus bone
Sea Bass	<i>Dicentrarchus labrax</i>	60	Muscle minus skin minus bone
Turbot	<i>Psetta maxima</i>	60	Muscle minus skin minus bone
Sea Trout	<i>Salmo trutta</i>	60	Muscle minus skin minus bone
Sea Bream (gilthead)	<i>Sparus aurata</i>	60	Muscle minus skin minus bone
Halibut	<i>Hippoglossus hippoglossus</i>	60	Muscle minus skin minus bone

Notes: * No fish or shellfish canned in oil was purchased for these composites.

** Fish pastes include pastes and spreads labelled as crab, sardine, salmon, tuna, bloater and fish.

Table 2: Concentrations of dioxins and dioxin-like PCBs in farmed and wild fish and shellfish

	No of samples*	Concentrations (ng WHO-TEQ/kg fresh weight) (mean, standard deviation in brackets)		
		Dioxins	PCBs	Total
Herring	1	1.5	2.2	3.6
Herring (individual)	30	0.7-2.7 (1.5, 0.6)	0.6-6.9 (1.9, 1.2)	1.3-9.5 (3.3, 1.7)
Trout (farmed, individual)	28	0.2-0.4 (0.3, 0.08)	0.4-1.2 (0.8, 0.2)	0.6-1.6 (1.1, 0.2)
Trout (farmed)	1	0.3	0.7	1.0
Organic trout (individual)	6	0.2-0.3 (0.3, 0.05)	0.5-0.8 (0.7, 0.07)	0.7-1.1 (0.9, 0.1)
Sea trout (farmed)	1	0.4	1.0	1.4
Atlantic salmon (wild, individual)	30	0.03-1.1 (0.5, 0.3)	0.07-2.8 (0.9, 0.5)	0.1-3.6 (1.4, 0.8)
Atlantic salmon (wild)	1	0.5	1.1	1.6
Alaskan salmon (wild)	1	0.09	0.2	0.3
Atlantic salmon (farmed, individual)	30	0.3-0.9 (0.6, 0.2)	1.0-2.6 (1.8, 0.5)	1.3-3.4 (2.4, 0.7)
Atlantic salmon (farmed)	1	0.7	1.9	2.6
Organic salmon – individual	4	0.4-0.7 (0.6, 0.2)	1.1-2.0 (1.7, 0.5)	1.5-2.7 (2.3, 0.6)
Mackerel (individual)	30	0.1-6.9 (0.7, 1.3)	0.4-21 (1.9, 3.8)	0.5-28 (2.6, 5.0)
Mackerel	1	0.4	1.5	1.9
Mackerel (canned)	1	0.1	1.2	1.3
Cod	1	0.03	0.07	0.1
Lemon sole	1	0.2	0.2	0.4
Whitebait	1	1.1	2.1	3.1
Sardines/pilchards	1	1.1	4.9	6.0
Wild halibut	1	0.3	0.8	1.1
Halibut (farmed)	1	0.7	1.7	2.4
Coley	1	0.03	0.1	0.2
Hake	1	0.1	0.5	0.6
Whiting	1	0.04	0.05	0.09
Sprat	1	1.8	2.5	4.3
Eel	1	0.4	0.9	1.3
Haddock	1	0.03	0.04	0.07
Plaice	1	0.3	0.4	0.7
Sea bass (wild)	1	0.7	3.0	3.7
Sea bass (farmed)	1	0.3	1.2	1.5
Turbot (wild, UK)	1	0.4	1.2	1.5
Turbot (wild, Greenland)	1	0.8	1.6	2.3
Turbot (farmed, UK)	1	0.2	0.8	1.0
Tuna (fresh)	1	0.01	0.06	0.07
Swordfish	1	0.1	0.6	0.7

Table 2 (continued): Concentrations of dioxins and dioxin-like PCBs in farmed and wild fish and shellfish

	No of samples*	Concentrations (ng WHO-TEQ/kg fresh weight)		
		Dioxins	PCBs	Total
Wild shark	1	0.04	0.09	0.1
Wild dogfish	1	0.6	1.6	2.2
Sea bream (farmed)	1	0.3	1.2	1.5
Red snapper	1	0.04	0.08	0.1
Crab (white+brown meat)	1	2.2	1.4	3.6
Scampi	1	0.2	0.09	0.2
Prawns (warm water)	1	0.04	0.03	0.07
Prawns (cold water)	1	0.04	0.06	0.1
Mussels	1	0.1	0.1	0.3
Scallops	1	0.05	0.02	0.07
Oysters	1	0.3	0.2	0.5
Surimi	1	0.01	0.004	0.02
Rollmops	1	0.8	0.9	1.7
Fish paste	1	0.4	2.4	2.8
Crab (canned)	1	0.07	0.08	0.2
Anchovy (canned)	1	0.04	0.5	0.6
Salmon (canned)	1	0.1	0.5	0.7
Sardines (canned)	1	0.1	2.2	2.3
Tuna (canned)	1	0.01	0.02	0.03
Pilchard (canned)	1	0.09	1.2	1.3

* Where 1 sample is indicated this is a composite which consisted of 30 or 60 individual items.

Table 3: Summary of average upper bound concentrations (ng WHO-TEQ/kg fresh weight) of dioxins and dioxin-like PCBs in fish sampled in 1994-96 and 2003-04

Species	Concentrations (ng WHO-TEQ/kg fresh weight) (number of samples in 1994-96)					
	Dioxins		PCBs		Dioxins+PCBs	
	1994-96 (mean)	2003/04	1994-96 (mean)	2003/04	1994-96 (mean)	2003/04
Cod	0.04 (30)	0.03	0.07 (30)	0.07	0.1 (30)	0.1
Haddock	0.03 (26)	0.03	0.03 (26)	0.04	0.06 (26)	0.07
Plaice	0.3 (13)	0.3	0.5 (13)	0.4	0.8 (13)	0.7
Whiting	0.04 (14)	0.04	0.1 (14)	0.05	0.1 (14)	0.09
Herring	2.4 (10)	1.5	6.2 (10)	2.2	8.6 (10)	3.6
Mackerel	0.7 (13)	0.4	2.5 (13)	1.5	3.1 (13)	1.9
Farmed salmon	0.8 (12)	0.7	2.4 (12)	1.9	3.2 (12)	2.6
Farmed trout	0.3 (40)	0.3	0.9 (40)	0.7	1.1 (40)	1.0
Eels	2.0 (10)*	0.4	8.2 (10)*	0.9	10 (10)*	1.3

Notes: The concentrations in 2003-04 are those found in the composite samples of the fresh fish species. The concentrations in 1994-96 have been taken from Food Surveillance Information Sheets Nos. 145 (farmed trout) and 184 (other species),^{3,2} re-expressed as ng WHO-TEQ/kg fresh weight. The figures are the average concentrations in all the samples of a given fish, both UK landed and imported.
* Eels were sampled in 1992.⁴

Table 4: Summary of upper bound concentrations (ng WHO-TEQ/kg fresh weight) of dioxins and dioxin-like PCBs in shellfish

Species (number of samples in 1998 or 2001)	<i>Upper bound concentrations (ng WHO-TEQ/kg fresh weight)</i>					
	Dioxins		PCBs		Dioxins+PCBs	
	1998 (mean)	2003	1998 (mean)	2003	1998 (mean)	2003
Crabs - 1998 (whole) (5)	7.6	2.2	6.7	1.4	14	3.6
Crabs - 2001 (whole) (5)	(1.4)	2	(1.0)	1.4	(2.4)	3.6
White meat only*	0.2	(0.3)	0.1	(0.2)	0.3	(0.5)
Mussels (5)	0.5	0.1	0.4	0.1	0.9	0.3
Oysters (3)	1.0	0.3	0.7	0.2	2.0	0.5
Scallops (4)	0.1	0.05	0.06	0.02	0.2	0.07
Scampi (5)	0.1	0.2	0.1	0.09	0.1	0.2
Prawns, cold water (8)	0.04	0.04	0.1	0.06	0.1	0.1
Prawns, warm water (4)	0.04	0.04	0.01	0.03	0.1	0.07

Notes: Combined concentrations of dioxins & dioxin-like PCBs may not equal the sum of the separate concentrations due to rounding. Concentrations in brackets are estimated.

* The EU Maximum Limit for dioxins applies to the white meat of crab only.³⁶

Table 5 Upper bound intakes (pg WHO-TEQ/kg bodyweight/day) of dioxins and dioxin-like PCBs from farmed and wild fish and shellfish (2003) and the rest of the diet

	Species	Sprat	Wild Sea Bass	Herring	Sardine/Pilchard	Farmed salmon	Farmed Halibut	Turbot (Greenland)	Mackerel	Dogfish	Crab (brown/white)	Whitebait	Wild Turbot (UK)	Wild salmon
Intake from non-fish part of the diet (a)	0.7													
Sub-total	0.7													
Concentration in oily fish (ng WHO-TEQ/kg fresh weight)		4.29	3.71	3.47	5.96	2.51	2.43	2.33	2.22	2.15	3.59	3.13	1.54	1.51
Fish portion size (gram)		140	140	140	70	140	140	140	140	140	70	70	140	140
Daily intake from one weekly portion of fish		1.4	1.2	1.2	1	0.8	0.8	0.8	0.7	0.7	0.6	0.5	0.5	0.5
Total		2.1	1.9	1.8	1.7	1.5	1.5	1.4	1.4	1.4	1.3	1.2	1.2	1.2
Daily intake from two weekly portions of fish		2.9	2.5	2.3	2	1.7	1.6	1.6	1.5	1.4	1.2	1	1	1
Total		3.5	3.1	3	2.6	2.3	2.3	2.2	2.1	2.1	1.9	1.7	1.7	1.7

Notes: Intakes from farmed and wild salmon, farmed trout, herring and mackerel are estimated from the weighted average of the concentrations in the individual samples and composites.

(a) Estimated from the results of the 2001 Total Diet Study.¹

Table 5 (continued) Upper bound intakes (pg WHO-TEQ/kg bodyweight/day) of dioxins and dioxin-like PCBs from farmed and wild fish and shellfish (2003) and the rest of the diet

	Species	Farmed Sea Bream	Farmed Sea Bass	Farmed Sea Trout	Canned sardines	Wild Halibut	Farmed Trout	Farmed Turbot	Herring (Rollmop)	Canned mackerel	Eel	Canned pilchards	Swordfish
Intake from non-fish part of the diet	0.7												
Sub-total	0.7												
Concentration in fish (ng WHO-TEQ/kg fresh weight)		1.48	1.46	1.42	2.34	1.09	1.02	1.01	1.67	1.28	1.31	1.25	0.72
Fish portion size (gram)		140	140	140	70	140	140	140	70	70	70	70	140
Daily intake from one weekly portion of fish		0.5	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2
Total		1.2	1.1	1.1	1.0	1	1	1	0.9	0.9	0.9	0.9	0.9
Daily intake from two weekly portions of fish		1	1	0.9	0.8	0.7	0.7	0.7	0.6	0.6	0.4	0.4	0.5
Total		1.6	1.6	1.6	1.4	1.4	1.3	1.3	1.2	1.1	1.1	1.1	1.1

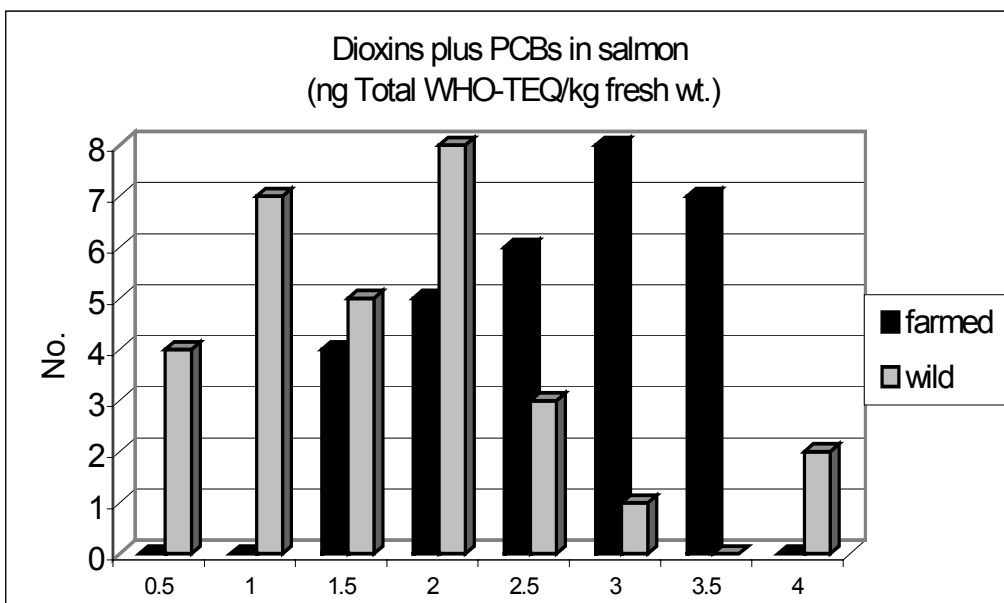
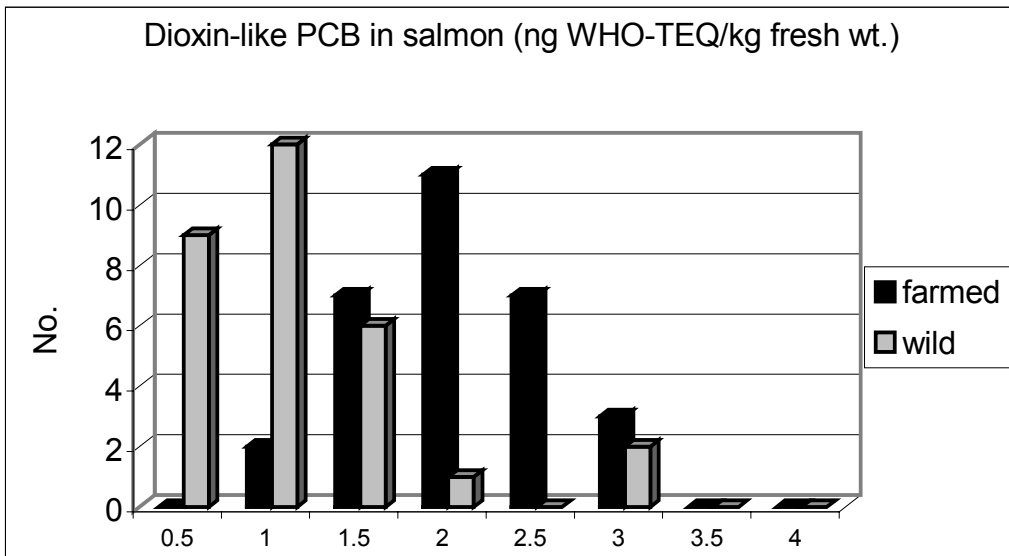
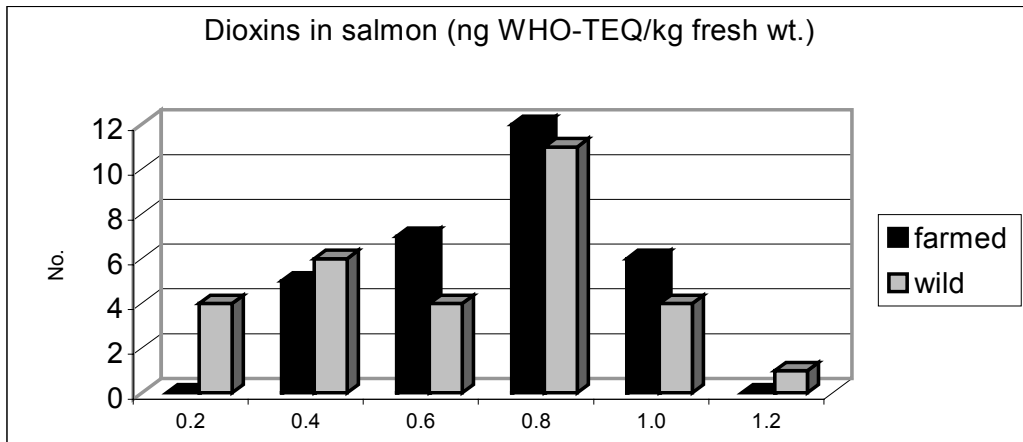
Table 5 (continued) Upper bound intakes (pg WHO-TEQ/kg bodyweight/day) of dioxins and dioxin-like PCBs from farmed and wild fish and shellfish (2003) and the rest of the diet

Species		Plaice	Hake	Canned salmon	Fish paste	Lemon Sole	Surimi	Salmon (Alaskan wild)	Coley	Prawns cold	Scallops	Oysters	Mussels
Intake from non-fish part of the diet	0.7												
Sub-total	0.7												
Concentration in fish (ng WHO-TEQ/kg fresh weight)		0.7	0.59	0.65	2.4	0.43	0.02	0.25	0.16	0.1	0.07	0.45	0.28
Fish portion size (gram)		140	140	70	30	140	30	140	140	70	70	70	70
Daily intake from one weekly portion of fish		0.2	0.2	0.1	0.2	0.1	0.001	0.08	0.05	0.02	0.01	0.1	0.05
Total		0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Daily intake from two weekly portions of fish		0.5	0.4	0.2	0.3	0.3	0.002	0.2	0.1	0.03	0.02	0.2	0.09
Total		1.1	1.1	0.9	1	0.9	0.7	0.8	0.8	0.7	0.7	0.8	0.8

Table 5 (continued) Upper bound intakes (pg WHO-TEQ/kg bodyweight/day) of dioxins and dioxin-like PCBs from farmed and wild fish and shellfish (2003) and the rest of the diet

Species		Canned anchovy	Scampi	Shark	Red snapper	Canned crab (white)	Cod	Whiting	Haddock	Tuna	Prawns warm	Canned tuna
Intake from non-fish part of the diet	0.7											
Sub-total	0.7											
Concentration in fish (ng WHO-TEQ/kg fresh weight)		0.58	0.24	0.13	0.12	0.15	0.1	0.09	0.07	0.07	0.07	0.02
Fish portion size (gram)		30	70	140	140	70	140	140	140	140	70	70
Daily intake from one weekly portion of fish		0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.01	0.004
Total		0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Daily intake from two weekly portions of fish		0.08	0.08	0.09	0.08	0.05	0.06	0.06	0.05	0.05	0.02	0.007
Total		0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7

Figure 1 – Distribution of Dioxins and Dioxin-like PCBs in Farmed and Wild Salmon



Appendix 1

Survey for Dioxins and Dioxin-like PCBs in Shellfish and Crustaceans

The Ministry of Agriculture, Fisheries and Food carried out a survey for dioxins and PCBs in shellfish and crustaceans in 1997/8 and the Food Standards Agency followed this up with a further study of crab meat in 2001. The analysis and reporting of the results was delayed by the need to divert resources to analysing food samples taken during the 2001 Foot and Mouth Disease outbreak. However, in order to permit an examination of time trends, the results from the previous work are published here.

A total of 51 samples of 14 classes, comprising a total of 18 species, of shellfish landed in or imported into the UK. The samples were selected as far as possible to reflect the market shares at that time of the five most commonly consumed species. Small numbers of other species were included to give indications of concentrations. The samples were obtained from shellfish on sale at Billingsgate Market, London, by staff from the Fishmongers' Company, Fisheries Inspectors' Offices during the period October 1997 and September 1998. In 2001, the Food Standards Agency carried out follow up work on crabs, in which the brown and white meat of five retail cooked crabs were analysed separately. A list of the samples, together with results, is presented in Tables 6a and 6b.

Further information can be found in the contractor's final reports for the survey and follow-up work.^{11,12}

Table 6a: Summary of upper bound concentrations (ng WHO-TEQ/kg fresh weight) of dioxins & dioxin-like PCBs in shellfish 1998

Species (number of samples)	Upper bound concentrations (ng WHO-TEQ/kg fresh weight)					
	Dioxins		PCBs		Dioxins+PCBs	
	Mean	Range	Mean	Range	Mean	Range
<i>UK samples:</i>						
Clams, Palourde (1)	0.1	-	0.1	-	0.2	-
Clams, Venus (1)	0.4	-	0.8	-	1.2	-
Cockles (2)	0.04	0.02-0.06	0.1	0.04-0.05	0.1	0.06-0.1
Crabs - 1998 (5)*	7.6	4-18	6.7	2.9-11	14	7.1-25
<i>Crabs - 2001: (5)</i>						
White meat*	0.2	0.08-0.3	0.1	0.04-0.2	0.3	0.1-0.5
Brown meat*	2.8	1-5.5	1.9	0.7-3.8	4.6	1.7-9.3
Mussels (5)	0.5	0.2-0.9	0.4	0.1-0.8	0.9	0.3-1.6
Oysters (3)	1.0	0.4-1.5	0.7	0.2-1.1	2.0	0.7-2.3
Scallops (4)	0.1	0.03-0.2	0.1	0.02-0.1	0.2	0.1-0.3
Scampi (5)	0.1	0.05-0.2	0.1	0.03-0.09	0.1	0.09-0.2
Whelks (2)	0.7	0.7-0.8	1.0	1.0-1.1	1.8	1.6-1.9
Winkles (2)	0.2	0.2-0.2	0.7	0.5-0.8	0.9	0.7-1.0
<i>Imported samples:</i>						
Clams, Amante (2)	0.2	0.2-0.2	0.1	0.08-0.1	0.3	0.3-0.3
Clams, Palourde (1)	0.1	-	0.1	-	0.2	-
Lobsters (1)	0.02	-	0.02	-	0.04	-
Mussels, green lipped (1)	0.1	-	0.1	-	0.1	-
Oysters (1)	1.4	-	0.7	-	2.1	-
Prawns, Black Tiger (2)	0.05	0.04,0.06	0.02	0.01,0.03	0.07	0.05,0.09
Prawns, cold water (8)	0.04	0.01-0.09	0.1	0.02-0.1	0.1	0.03-0.2
Prawns, warm water (4)	0.04	0.01-0.1	0.01	0.01-0.02	0.1	0.02-0.1
Shrimps, Black Tiger (1)	0.02	-	0.03	-	0.1	-

Note: * The EU Maximum Limits and Action Levels apply only to the white meat of crab.³⁶

Table 6b: Summary of lower bound concentrations (ng WHO-TEQ/kg fresh weight) of dioxins & dioxin-like PCBs in shellfish 1998

Species (number of samples)	Concentrations (ng WHO-TEQ/kg fresh weight)					
	Dioxins		PCBs		Dioxins+PCBs	
	Mean	Range	Mean	Range	Mean	Range
<i>UK samples:</i>						
Clams, Palourde (1)	0.1	-	0.1	-	0.2	-
Clams, Venus (1)	0.4	-	0.8	-	1.2	-
Cockles (2)	0.04	0.02-0.06	0.04	0.03-0.04	0.1	0.05-0.1
Crabs - 1998 (whole) (5)	7.6	4-18	6.7	2.9-11	14	7.1-25
<i>Crabs - 2001: (5)</i>						
White meat only	0.2	0.08-0.3	0.1	0.04-0.2	0.3	0.1-0.5
Brown meat only	2.8	1-5.5	1.9	0.7-3.8	4.6	1.7-9.3
Mussels (5)	0.5	0.2-0.9	0.4	0.1-0.8	0.9	0.3-1.6
Oysters (3)	1.0	0.4-1.5	0.7	0.2-1.1	2.0	0.6-2.3
Scallops (4)	0.1	0.03-0.2	0.06	0.02-0.1	0.2	0.1-0.3
Scampi (5)	0.08	0.05-0.2	0.05	0.02-0.09	0.1	0.08-0.2
Whelks (2)	0.7	0.7-0.8	1.0	1.0-1.1	1.8	1.6-1.9
Winkles (2)	0.2	0.2-0.2	0.7	0.5-0.8	0.9	0.7-1.0
<i>Imported samples:</i>						
Clams, Amante (2)	0.2	0.2-0.2	0.1	0.08-0.1	0.3	0.3-0.3
Clams, Palourde (1)	0.1	-	0.1	-	0.2	-
Lobsters (1)	0.02	-	0.02	-	0.04	-
Mussels, green lipped (1)	0.04	-	0.05	-	0.1	-
Oysters (1)	1.4	-	0.7	-	2.1	-
Prawns, Black Tiger (2)	0.05	0.04,0.06	0.02	0.01,0.03	0.07	0.05,0.09
Prawns, cold water (8)	0.04	0.01-0.09	0.1	0.01-0.1	0.1	0.02-0.2
Prawns, warm water (4)	0.04	0.01-0.09	0.01	0.01-0.02	0.06	0.02-0.1
Shrimps, Black Tiger (1)	0.02	-	0.03	-	0.05	-

Table 7a. List of farmed salmon samples obtained during 2003-04

Appendix 2

Product as described	Sample code	FSA Ref No	Country of origin	Brand	Retailer	Date purchased	Best before date
Salmon, side fillet	9345	2641 VE	Orkney	Sainsburys	Sainsbury's, Active Way, Burnley, BB11 1BS	2-Sep-03	3-Sep-03
Salmon, Scottish, side fillet	9346	2662 VE		Marks and Spencer	Marks & Spencer, 43 King William Street, Blackburn, Lancashire, BB1 7DN	4-Sep-03	9-Sep-03
Salmon, Scottish, side fillet	9347*	2669 VE	Scotland	Safeway	Safeway, Marston Road, Wolverhampton, WV2 4NJ	28-Aug-03	1-Sep-03
Salmon, Scottish, whole	9348	2671 VE		Morrisons	Morrisons, Central Drive, Morecambe, Lancashire, LA4 4DW	10-Sep-03	13-Sep-03
Salmon, steaks	9349	2680 VE	Norway	Tesco	Tesco Extra, Napier Road, Reading, Berkshire, RG1 8DF	12-Sep-03	13-Sep-03
Salmon, farmed	9404	2679 VE	Shetland		Jim Gough Ltd, 8-9 Upper Street, Tetterhall, Wolverhampton, West Midlands, WV6 8QQ	22-Aug-03	
Salmon, farmed	9511	2672 VE	Farmed in UK		Waitrose, Ryemarket Stourbridge West Midlands, DY8 1HJ	5-Nov-03	
Salmon, farmed	9512	2681 VE			Dockside Fish Ltd, Dock Street, Fleetwood, Lancashire, FY7 6NU	9-Oct-03	10-Oct-03
Salmon, farmed	9513	2682 VE	Scotland		ASDA Stores, Chalfont Way, Lower Earley, Reading, Berkshire, RG6 5TT	25-Oct-03	27-Oct-03
Salmon, farmed	9514	2695 VE			Mcleish Bros. Ltd, Brook Street, Brovenry Ferry, Dundee, DD5 2DX	29-Nov-03	
Salmon, side fillet	9848	2694 VE	Orkney		Sainsbury's, Kings Road, Newbury, Berkshire, RG14 5RB	3-Jan-04	4-Jan-04
Salmon, fillets	9849	2696 VE			Tesco, Friars Park, Carmarthen, Dyfed, SA31 3AN	16-Feb-04	17-Feb-04
Salmon, fillets	9850	2664 VE			ASDA, Lower Earley Store, 3 The Square, Reading, Berkshire, RG6 5HJ	7-Feb-04	9-Feb-04
Salmon, fillets	9851	2690 VE			Tesco, Kingsway Retail Park, Dundee, DD3 8QB	19-Jan-04	20-Jan-04
Salmon	9852	2686 VE			Bury Fish Market, BL9 0BD	7-Jan-04	8-Jan-04
Salmon, Scottish, fillets	9853	2661 VE	Scotland		Marks & Spencer, The County, 66 East Street, Taunton, Somerset, TA1 3LU	19-Dec-03	23-Dec-03
Salmon, fillets	9854	2657 VE	Scotland/ Norway		Tesco, Towngate Retail Park, Birmingham Road, Dudley, West Midlands, DY1 4RP	2-Oct-03	3-Oct-03

Table 7a. List of farmed salmon samples obtained during 2003-04 (continued)

Appendix 2

Product as described	Sample code	FSA Ref No	Country of origin	Brand	Retailer	Date purchased	Best before date
Salmon, Scottish, fillets	9855	2692 VE			Safeway, Burnside Drive, Arbroath, DD11 1HU	16-Feb-04	20-Feb-04
salmon side fillet	9856	2643 VE	Orkney		Sainsbury's, Hankeridge Farm, Heron Gate, Taunton, Somerset, TA1 2LR	13-Dec-03	14-Dec-03
Salmon, fillets	9857	2652 VE	Scotland		Tesco, The Meadows, Marshall Road, College Town, Sandhurst, Berkshire, GU47 0FD	6-Jan-04	7-Jan-04
Salmon, fillets	9858	2648 VE			Sainsbury's, Merry Hill Centre, Brierley Hill, Dudley, DY5 1QH	12-Jan-04	14-Jan-04
Salmon, side fillet	9912	2645 VE			Sainsbury's, Anders Square, Coleridge Drive, Perton, Wolverhampton, WV6 7QH	10-Feb-04	11-Feb-04
Salmon, farmed	10188	2646 VE	Norway		Sainsbury's, Kings Road, Newbury, Berkshire, RG14 5RB	10-Apr-04	12-Apr-04
Salmon	10195	2687 VE	UK		Waitrose, 45-53 The Broadway, Thatcham, Berkshire, RG19 3HN	15-Apr-04	
Salmon, farmed	10196	2697 VE			Sainsbury's, Y Dderwen, Penybond, Bridgend, CF32 9ST	19-Apr-04	20-Apr-04
Salmon, farmed	10197	2699 VE			Tesco, 369-383 Lisburn Road, Belfast, BT9 5AD	6-Nov-03	7-Nov-03
Salmon, farmed	10198	2647 VE			Morrisons, Railway Road, Blackburn, Lancashire, BB1 5AZ	10-May-04	12-May-04
Salmon, farmed	10199	2658 VE			Tesco, Pinchington Lane, Greenham, Newbury, Berkshire, RG14 7HB	8-Apr-04	9-Apr-04
Salmon, farmed	10615	2688 VE			Passmore's Fish Game, 16 Butchers Row, Barnstaple, North Devon, EX31 1BW	6-May-04	
Salmon, farmed	10228	2700 VE			Walter Ewing, 124 Shankhill Road, Belfast, County Antrim, N.I., BT13 2BD	12-Feb-04	

Table 7b. Concentrations (ng WHO-TEQ/kg fresh weight) of dioxins and dioxin-like PCBs in farmed salmon

Appendix 2

Sample code	Species	Concentrations (ng WHO-TEQ/kg fresh weight)																	
		Upper bound									Lower bound								
		Dioxins			PCBs			DX+PCBs			Dioxins			PCBs			DX+PCBs		
9345	Farmed salmon	0.79	±	0.05	2.34	±	0.05	3.13	±	0.10	0.79	±	0.05	2.34	±	0.05	3.13	±	0.10
9346	Farmed salmon	0.88	±	0.06	2.15	±	0.04	3.03	±	0.10	0.88	±	0.06	2.15	±	0.04	3.03	±	0.11
9347	Farmed salmon	0.72	±	0.05	1.97	±	0.04	2.69	±	0.09	0.72	±	0.04	1.95	±	0.04	2.67	±	0.09
9348	Farmed salmon	0.75	±	0.05	2.11	±	0.05	2.86	±	0.09	0.75	±	0.05	2.09	±	0.05	2.84	±	0.09
9349	Farmed salmon	0.84	±	0.05	2.56	±	0.05	3.40	±	0.11	0.84	±	0.05	2.53	±	0.05	3.37	±	0.10
9404	Farmed salmon	0.81	±	0.04	2.55	±	0.04	3.36	±	0.09	0.81	±	0.05	2.55	±	0.04	3.36	±	0.09
9511	Farmed salmon	0.78	±	0.05	2.59	±	0.04	3.37	±	0.09	0.78	±	0.05	2.59	±	0.04	3.37	±	0.10
9512	Farmed salmon	0.61	±	0.04	1.76	±	0.03	2.37	±	0.07	0.61	±	0.04	1.76	±	0.03	2.37	±	0.07
9513	Farmed salmon	0.39	±	0.03	1.19	±	0.02	1.58	±	0.05	0.39	±	0.03	1.18	±	0.02	1.57	±	0.05
9514	Farmed salmon	0.61	±	0.04	1.69	±	0.03	2.30	±	0.07	0.61	±	0.04	1.69	±	0.03	2.30	±	0.07
9848	Farmed salmon	0.51	±	0.05	1.51	±	0.03	2.02	±	0.08	0.51	±	0.06	1.51	±	0.03	2.02	±	0.08
9849	Farmed salmon	0.36	±	0.04	1.03	±	0.02	1.39	±	0.06	0.36	±	0.04	1.03	±	0.02	1.39	±	0.06
9850	Farmed salmon	0.38	±	0.04	1.11	±	0.02	1.49	±	0.06	0.38	±	0.05	1.11	±	0.02	1.49	±	0.07
9851	Farmed salmon	0.64	±	0.05	1.97	±	0.04	2.61	±	0.09	0.64	±	0.05	1.97	±	0.04	2.61	±	0.09
9852	Farmed salmon	0.81	±	0.07	2.04	±	0.04	2.85	±	0.11	0.81	±	0.08	2.04	±	0.04	2.85	±	0.12
9853	Farmed salmon	0.79	±	0.06	2.09	±	0.04	2.88	±	0.10	0.79	±	0.07	2.09	±	0.04	2.88	±	0.11
9854	Farmed salmon	0.34	±	0.04	0.96	±	0.02	1.30	±	0.05	0.34	±	0.04	0.96	±	0.02	1.30	±	0.06
9855	Farmed salmon	0.59	±	0.05	1.57	±	0.03	2.16	±	0.08	0.59	±	0.06	1.57	±	0.03	2.16	±	0.08
9856	Farmed salmon	0.73	±	0.06	1.98	±	0.03	2.71	±	0.10	0.73	±	0.07	1.98	±	0.03	2.71	±	0.10
9857	Farmed salmon	0.45	±	0.05	1.44	±	0.03	1.89	±	0.07	0.45	±	0.05	1.44	±	0.03	1.89	±	0.08
9858	Farmed salmon	0.62	±	0.05	1.92	±	0.03	2.54	±	0.08	0.62	±	0.05	1.92	±	0.03	2.54	±	0.09
9912	Farmed salmon	0.90	±	0.07	2.43	±	0.05	3.33	±	0.11	0.90	±	0.07	2.43	±	0.05	3.33	±	0.12
10188	Farmed salmon	0.60	±	0.03	1.69	±	0.03	2.29	±	0.40	0.60	±	0.04	1.69	±	0.03	2.29	±	0.06
10195	Farmed salmon	0.70	±	0.06	1.94	±	0.03	2.64	±	0.10	0.70	±	0.07	1.94	±	0.03	2.64	±	0.11
10196	Farmed salmon	0.49	±	0.06	1.34	±	0.02	1.83	±	0.08	0.49	±	0.06	1.34	±	0.02	1.83	±	0.08
10197	Farmed salmon	0.83	±	0.08	2.48	±	0.04	3.31	±	0.12	0.83	±	0.09	2.48	±	0.04	3.31	±	0.13
10198	Farmed salmon	0.40	±	0.05	0.99	±	0.02	1.39	±	0.06	0.40	±	0.05	0.99	±	0.02	1.39	±	0.07
10199	Farmed salmon	0.43	±	0.05	1.40	±	0.03	1.83	±	0.07	0.43	±	0.06	1.40	±	0.03	1.83	±	0.08
10615	Farmed salmon	0.46	±	0.03	1.25	±	0.03	1.71	±	0.05	0.46	±	0.04	1.25	±	0.03	1.71	±	0.06
10228	Farmed salmon	0.67	±	0.05	1.75	±	0.03	2.42	±	0.08	0.67	±	0.05	1.75	±	0.03	2.42	±	0.08
Average	Farmed salmon	0.63	±	0.05	1.79	±	0.03	2.42	±	0.09	0.63	±	0.05	1.79	±	0.03	2.42	±	0.09

Table 8a. List of wild salmon samples obtained during 2003-04

Appendix 2

Product as described	Sample code	FSA Ref No	Country of origin	Brand	Retailer	Date purchased	Best before date
Salmon, fresh Atlantic wild, steaks	9402	1196 EM			A. M. Anderson of Crail, 77 Gray Street, Brovenry Ferry, Dundee	29-Aug-03	
Salmon, fresh Atlantic wild	9405	1189 EM			Jim Gough Ltd, 8-9 Upper Street, Tettenhall, Wolverhampton, West Midlands	22-Aug-03	
Salmon, Atlantic	9914	1173 EM			The Shrimp & Fish Shop, rear of 173, Lord Street, Fleetwood, Lancashire	13-Sep-03	
Salmon, Wild Atlantic	10200	1143 EM			H Satchwell, Bullring Indoor Market, Edgbaston Street, Birmingham, West Midlands	11-Jun-04	12-Jun-04
Fresh Atlantic wild salmon	10673	1177 EM			H Satchwell, Bullring Indoor Market, Edgbaston Street, Birmingham, West Midlands	8-Jul-04	9-Jul-04
Salmon, Wild Atlantic	10227	1179 EM			H Satchwell, Bullring Indoor Market, Edgbaston Street, Birmingham, West Midlands	18-Jun-04	19-Jun-04
Salmon, Wild Atlantic	10229	1193 EM			A. M. Anderson of Crail, 77 Gray Street, Brovenry Ferry, Dundee	26-May-04	
Salmon, Atlantic	10662	1156 EM			Phil Bowditch, 7 Bath Place Taunton, Somerset	15-Jul-04	
Fresh Atlantic wild salmon	10663	1145 EM			S & P Fish, 9 Butchers Row , Barnstable North Devon	1-Jul-04	
Salmon, fresh Atlantic wild	10664	1164 EM			S & P Fish, 9 Butchers Row Barnstaple North Devon	30-Jul-04	
	10666	1200EM			H Satchwell, Bullring Indoor Market, Edgbaston Street, Birmingham, West Midlands	20-Aug-04	21-Aug-04
Salmon, fresh Atlantic wild	10667	1184 EM			Phil Bowditch, 7 Bath Place Taunton, Somerset	19-Jun-04	
Salmon, fresh Atlantic wild	10668	1178 EM			H Satchwell, Bullring Indoor Market, Edgbaston Street, Birmingham, West Midlands	25-Jun-04	26-Jun-04
	10669	1174 EM			S & P Fish, 9 Butchers Row , Barnstable North Devon	22-Jul-04	

Table 8a. List of wild salmon samples obtained during 2003-04 (continued)

Appendix 2

Product as described	Sample code	FSA Ref No	Country of origin	Brand	Retailer	Date purchased	Best before date
Salmon, fresh Atlantic wild	10670	1160 EM			Phil Bowditch, 7 Bath Place Taunton, Somerset	17-Aug-04	
Salmon, fresh Atlantic wild	10671	1144 EM			The Fishmonger, 107a High Street, Honiton, Devon	15-Jul-04	
	10672	1147 EM			The Fishmonger, 107a High Street, Honiton, Devon	14-Jul-04	
Salmon, fresh Atlantic wild	10962	1180 EM			Waitrose, Ryemarket, Stourbridge, West Midlands	25-Jun-04	
Salmon, Wild Atlantic	10964	1141 EM			S & P Fish, 9 Butchers Row , Barnstable North Devon	16-Jul-04	
	10929	1199 EM			The Fishmonger, 107a High Street, Honiton, Devon	25-Aug-04	
Salmon, Wild Atlantic	10930	1175 EM			Savills, 3a St James Street, South Pertherton, Somerset	10-Aug-04	
Salmon, Wild Atlantic	10952	1186 EM			Phil Bowditch, 7 Bath Place Taunton, Somerset	23-Jun-04	
	10953	1162 EM			Waitrose, Ryemarket, Stourbridge, West Midlands	19-Jul-04	20-Jul-04
Salmon, Wild Atlantic	10954	1151 EM			Phil Bowditch, 7 Bath Place Taunton, Somerset	19-Aug-04	
Salmon, Wild Atlantic	10955	1167 EM			H Satchwell, Bullring Indoor Market, Edgbaston Street, Birmingham, West Midlands	21-Jul-04	22-Jul-04
	10956	1153 EM			Phil Bowditch, 7 Bath Place Taunton, Somerset	14-Jul-04	
Salmon, Wild Atlantic	10958	1190 EM			Waitrose, Ryemarket, Stourbridge, West Midlands	23-Aug-04	24-Aug-04
Salmon, Wild Atlantic	10951	1159 EM			Fruits of the sea, 23 North View, Westbury Park, Bristol	22-Jul-04	
Salmon, Atlantic	10969	1171 EM			Phil Bowditch, 7 Bath Place Taunton, Somerset	15-Jul-04	
Salmon, Atlantic	11201	1161 EM			S & J Fisheries, Unit 6-8 The Fish Quay Sutton Harbour Plymouth	25-Aug-04	

Table 8b. Concentrations (ng WHO-TEQ/kg fresh weight) of dioxins and dioxin-like PCBs in wild salmon samples obtained during 2003-04 Appendix 2

		Concentrations (ng WHO-TEQ/kg fresh weight)																	
Sample		Upper bound									Lower bound								
code	Species	Dioxins			PCBs			DX+PCBs			Dioxins			PCBs			DX+PCBs		
9402	Wild salmon	0.80	±	0.05	2.77	±	0.05	3.57	±	0.10	0.80	±	0.06	2.77	±	0.05	3.57	±	0.11
9405	Wild salmon	0.68	±	0.04	1.03	±	0.02	1.71	±	0.06	0.68	±	0.04	1.02	±	0.02	1.70	±	0.06
9914	Wild salmon	0.43	±	0.05	0.63	±	0.02	1.06	±	0.07	0.43	±	0.06	0.63	±	0.01	1.06	±	0.08
10200	Wild salmon	0.97	±	0.09	1.22	±	0.02	2.19	±	0.11	0.97	±	0.10	1.22	±	0.02	2.19	±	0.12
10673	Wild salmon	0.29	±	0.04	0.36	±	0.01	0.65	±	0.04	0.29	±	0.04	0.36	±	0.01	0.65	±	0.04
10227	Wild salmon	0.37	±	0.02	0.47	±	0.01	0.84	±	0.03	0.37	±	0.02	0.47	±	0.01	0.84	±	0.03
10229	Wild salmon	0.90	±	0.06	2.63	±	0.04	3.53	±	0.10	0.89	±	0.05	2.63	±	0.04	3.52	±	0.09
10662	Wild salmon	0.70	±	0.06	0.88	±	0.02	1.58	±	0.08	0.70	±	0.06	0.88	±	0.02	1.58	±	0.08
10663	Wild salmon	0.76	±	0.05	1.00	±	0.02	1.76	±	0.07	0.76	±	0.06	1.00	±	0.02	1.76	±	0.08
10664	Wild salmon	0.25	±	0.03	0.31	±	0.01	0.56	±	0.04	0.25	±	0.03	0.31	±	0.01	0.56	±	0.04
10666	Wild salmon	0.04	±	0.01	0.09	±	0.01	0.13	±	0.02	0.02	±	0.00	0.09	±	0.01	0.11	±	0.01
10667	Wild salmon	1.06	±	0.07	1.35	±	0.03	2.41	±	0.10	1.06	±	0.07	1.35	±	0.03	2.41	±	0.10
10668	Wild salmon	0.80	±	0.05	1.04	±	0.02	1.84	±	0.07	0.80	±	0.05	1.04	±	0.02	1.84	±	0.07
10669	Wild salmon	0.43	±	0.04	0.55	±	0.01	0.98	±	0.06	0.43	±	0.05	0.55	±	0.01	0.98	±	0.06
10670	Wild salmon	0.50	±	0.05	0.68	±	0.02	1.18	±	0.07	0.50	±	0.05	0.68	±	0.02	1.18	±	0.07
10671	Wild salmon	0.63	±	0.06	0.69	±	0.01	1.32	±	0.07	0.63	±	0.06	0.69	±	0.01	1.32	±	0.08
10672	Wild salmon	0.63	±	0.06	0.74	±	0.01	1.37	±	0.07	0.62	±	0.06	0.74	±	0.01	1.36	±	0.07
10962	Wild salmon	0.03	±	0.01	0.07	±	0.00	0.10	±	0.01	0.02	±	0.00	0.07	±	0.00	0.09	±	0.00
10964	Wild salmon	0.34	±	0.03	0.53	±	0.01	0.87	±	0.04	0.33	±	0.03	0.52	±	0.01	0.85	±	0.04
10929	Wild salmon	0.66	±	0.05	0.88	±	0.02	1.54	±	0.07	0.66	±	0.05	0.88	±	0.02	1.54	±	0.07
10930	Wild salmon	0.44	±	0.04	0.69	±	0.02	1.13	±	0.05	0.44	±	0.04	0.69	±	0.02	1.13	±	0.06
10952	Wild salmon	0.68	±	0.04	0.87	±	0.01	1.55	±	0.06	0.68	±	0.04	0.87	±	0.01	1.55	±	0.06
10953	Wild salmon	0.28	±	0.03	0.40	±	0.01	0.68	±	0.03	0.28	±	0.03	0.40	±	0.01	0.68	±	0.03
10954	Wild salmon	0.68	±	0.05	0.94	±	0.02	1.62	±	0.07	0.67	±	0.05	0.94	±	0.02	1.61	±	0.07
10955	Wild salmon	0.69	±	0.05	1.16	±	0.02	1.85	±	0.07	0.69	±	0.05	1.16	±	0.02	1.85	±	0.07
10956	Wild salmon	0.91	±	0.06	1.22	±	0.02	2.13	±	0.08	0.91	±	0.06	1.22	±	0.02	2.13	±	0.08
10958	Wild salmon	0.03	±	0.01	0.09	±	0.00	0.12	±	0.02	0.02	±	0.00	0.09	±	0.00	0.11	±	0.00
10951	Wild salmon	0.99	±	0.06	1.81	±	0.03	2.80	±	0.09	0.99	±	0.06	1.81	±	0.03	2.80	±	0.09
10969	Wild salmon	0.31	±	0.04	0.38	±	0.01	0.69	±	0.05	0.30	±	0.05	0.38	±	0.12	0.68	±	0.17
11201	Wild salmon	0.05	±	0.02	0.12	±	0.01	0.17	±	0.02	0.04	±	0.02	0.12	±	0.12	0.16	±	0.14
Average	Wild salmon	0.54	±	0.04	0.85	±	0.02	1.40	±	0.06	0.54	±	0.04	0.85	±	0.02	1.39	±	0.07

Table 9a. List of farmed rainbow trout samples obtained during 2003-04

Appendix 2

Product as described	Sample code	FSA Ref No	Country of origin	Brand	Retailer	Date purchased	Best before date
Trout	9341	2581 TD			Sainsbury's, Active Way, Burnley, BB11 1BS	2-Sep-03	3-Sep-03
Trout	9342	2588 TD			R J Sands, Bilston Indoor Market, Bilston, Wolverhampton, West Midlands, WV14 0EH	6-Sep-03	
Trout, whole	9343	2611 TDS			Morrisons, Central Drive, Morecambe, Lancashire, LA4 4DW	10-Sep-03	12-Sep-03
Trout, filleted	9344	2612 TD			Jim Gough Ltd, 8-9 Upper Street, Tettenhall, Wolverhampton, West Midlands, WV6 8QQ	22-Aug-03	
Farmed, Rainbow trout	9403	2629 S			Tesco, Riverside Drive, Dundee, Tayside, DD2 1UG	27-Aug-03	28-Aug-03
Trout	9406	2614 TDS			Morrisons, Railway Road, Blackburn, Lancashire, BB1 5AZ	29-Aug-03	31-Aug-03
Trout, whole gutted fish	9515	2583 TDS			Sainsbury's, Sedlescombe Road, John Macadam Way, St Leonard on Sea, East Sussex, TN37 7SQ	28-Oct-03	29-Oct-03
Trout	9516	2600 TDS	Scotland		Marks & Spencer, 37 Mill Lane, Solihull, West Midlands, B91 3AT	6-Sep-03	11-Sep-03
Trout	9518	2617 TDS	UK		Somerfield, 23-25 High Street, Tettenhall, Wolverhampton, West Midlands, WV6 8QS	2-Oct-03	4-Oct-03
Trout	9519	2620 TDS	Scotland		Sainsbury's, Bagshot Road, Ringmead, Bracknell, Berkshire, RG12 7SS	7-Oct-03	8-Oct-03
Trout	9520	2633 TDS			ASDA, Milton of Craigie, Kingsway, Dundee, DD4 7RX	30-Sep-03	
Trout, fillets	9831	2586 TDS			Sainsbury's, Kings Road, Newbury, Berkshire, RG14 5RB	8-Feb-04	10-Feb-04
Trout, fillets	9832	2622 TDS			Safeway, High Wycombe, Buckinghamshire, HP13 5XX	19-Jan-04	
Trout, Scottish Loch fillets	9833	2636 TDS	Scotland		Tesco, Fforestfach, Swansea, Wales, SA11 5EW	17-Feb-04	18-Feb-04
Trout, whole	9834	2627 TDS			Waitrose, 45-53 The Broadway, Thatcham, Berkshire, RG19 3HN	1-May-04	

Table 9a. List of farmed rainbow trout samples obtained during 2003-04 (continued)

Appendix 2

Product as described	Sample code	FSA Ref No	Country of origin	Brand	Retailer	Date purchased	Best before date
Trout, whole	9835	2630 TDS			Tesco, Kingsway Retail Park, Dundee, DD3 8QB	19-Jan-04	20-Jan-04
Farmed trout	9842	2601 TDS	Scotland		Marks & Spencer, The Meadows, Marshall Road, College Town, Sandhurst, Berkshire, GU47 0FD	6-Jan-04	8-Jan-04
Farmed trout	9843	2592 TDS			Tesco, The Meadows, Marshall Road, College Town, Sandhurst, Berkshire, GU47 0FD	6-Jan-04	7-Jan-04
Trout	9844	2624 TDS			A. J. Barlow, Bullring Indoor Market, Edgbaston Street, Birmingham, West Midlands, B5 4RQ	6-Feb-04	
Trout	9845	2628 TDS			The Fishmonger, 107a High Street, Honiton, Devon, EX14 1PE	24-Feb-04	
Trout, whole	9846	2623 TDS			Tesco, Rochdale Road, Todmorden, Lancashire, OL14 6LG	7-Jan-04	8-Jan-04
Trout, fillets	9847	2604 TD			Safeway, Viables, Basingstoke, Hantshire, RG21 1SD	7-Feb-04	10-Feb-04
Trout	10187	2597 TD			Tesco Stores Ltd Silver Street, Brownhills Walsal West Midlands, WS8 6DZ	14-Apr-04	
Trout	10226	2615 TD			Morrisons, Black Country Route, Bilston, Wolverhampton, West Midlands, WV14 0DZ	6-Apr-04	8-Apr-04
Trout	10230	2618 TD			Safeway, Armounderness Way, Thornton-Cleveleys, Lancashire, FY5 3TS	19-May-04	20-May-04
Trout	10616	2593 TD			Tesco Stores Ltd 31-41 Market Way, Blackburn, BB1 7JQ	7-Jun-04	8-Jun-04
Trout, fillets	10675	2595 TD			Tesco, Castle st Wellington rd Taunton, TA1 4AB	17-Jun-04	18-Jun-04
Trout	10232	2637 TD			Sainsbury's, Y Dderwen, Penybond, Bridgend, CF32 9ST	19-Apr-04	

Table 9b. Concentrations (ng WHO-TEQ/kg fresh weight) of dioxins and dioxin-like PCBs in farmed rainbow trout samples obtained during 2003-04

Sample code	Species	Concentrations (ng WHO-TEQ/kg fresh weight)																	
		Upper bound									Lower bound								
		Dioxins			PCBs			DX+PCBs			Dioxins			PCBs			DX+PCBs		
9341	Farmed trout	0.35	±	0.02	1.24	±	0.03	1.59	±	0.05	0.35	±	0.02	1.24	±	0.03	1.59	±	0.05
9342	Farmed trout	0.15	±	0.01	0.42	±	0.02	0.57	±	0.03	0.15	±	0.01	0.42	±	0.02	0.57	±	0.03
9343	Farmed trout	0.35	±	0.03	0.93	±	0.02	1.28	±	0.05	0.35	±	0.03	0.93	±	0.02	1.28	±	0.05
9344	Farmed trout	0.22	±	0.02	0.59	±	0.02	0.81	±	0.04	0.22	±	0.02	0.59	±	0.02	0.81	±	0.04
9403	Farmed trout	0.39	±	0.02	1.01	±	0.02	1.40	±	0.05	0.39	±	0.03	1.01	±	0.02	1.40	±	0.05
9406	Farmed trout	0.40	±	0.02	1.05	±	0.02	1.45	±	0.05	0.40	±	0.02	1.05	±	0.02	1.45	±	0.05
9515	Farmed trout	0.18	±	0.02	0.57	±	0.02	0.75	±	0.03	0.18	±	0.02	0.57	±	0.02	0.75	±	0.03
9516	Farmed trout	0.34	±	0.03	0.97	±	0.03	1.31	±	0.05	0.34	±	0.02	0.97	±	0.03	1.31	±	0.05
9518	Farmed trout	0.21	±	0.02	0.63	±	0.02	0.84	±	0.04	0.21	±	0.02	0.63	±	0.02	0.84	±	0.04
9519	Farmed trout	0.23	±	0.02	0.69	±	0.02	0.92	±	0.04	0.23	±	0.02	0.69	±	0.02	0.92	±	0.04
9520	Farmed trout	0.21	±	0.02	0.56	±	0.01	0.77	±	0.03	0.21	±	0.02	0.56	±	0.01	0.77	±	0.03
9831	Farmed trout	0.29	±	0.02	0.82	±	0.02	1.11	±	0.04	0.29	±	0.02	0.82	±	0.02	1.11	±	0.04
9832	Farmed trout	0.24	±	0.03	0.83	±	0.01	1.07	±	0.04	0.24	±	0.02	0.83	±	0.01	1.07	±	0.04
9833	Farmed trout	0.35	±	0.03	0.92	±	0.02	1.27	±	0.04	0.35	±	0.03	0.92	±	0.02	1.27	±	0.04
9834	Farmed trout	0.27	±	0.02	0.84	±	0.02	1.11	±	0.04	0.27	±	0.03	0.84	±	0.02	1.11	±	0.04
9835	Farmed trout	0.23	±	0.02	0.47	±	0.01	0.70	±	0.03	0.23	±	0.02	0.47	±	0.01	0.70	±	0.03
9842	Farmed trout	0.27	±	0.02	0.88	±	0.02	1.15	±	0.04	0.27	±	0.02	0.88	±	0.02	1.15	±	0.04
9843	Farmed trout	0.25	±	0.02	0.73	±	0.01	0.98	±	0.03	0.25	±	0.02	0.73	±	0.01	0.98	±	0.03
9844	Farmed trout	0.36	±	0.03	0.98	±	0.02	1.34	±	0.04	0.36	±	0.03	0.98	±	0.02	1.34	±	0.04
9845	Farmed trout	0.16	±	0.02	0.41	±	0.01	0.57	±	0.02	0.16	±	0.02	0.41	±	0.01	0.57	±	0.02
9846	Farmed trout	0.33	±	0.03	0.85	±	0.02	1.18	±	0.04	0.33	±	0.03	0.85	±	0.02	1.18	±	0.04
9847	Farmed trout	0.24	±	0.03	0.70	±	0.01	0.94	±	0.04	0.24	±	0.03	0.70	±	0.01	0.94	±	0.04
10187	Farmed trout	0.17	±	0.01	0.77	±	0.01	0.94	±	0.03	0.17	±	0.01	0.77	±	0.01	0.94	±	0.02
10226	Farmed trout	0.37	±	0.02	0.84	±	0.02	1.21	±	0.04	0.37	±	0.02	0.84	±	0.02	1.21	±	0.04
10230	Farmed trout	0.25	±	0.02	0.71	±	0.01	0.96	±	0.03	0.25	±	0.02	0.71	±	0.01	0.96	±	0.03
10616	Farmed trout	0.32	±	0.02	0.84	±	0.02	1.16	±	0.04	0.32	±	0.02	0.84	±	0.02	1.16	±	0.04
10675	Farmed trout	0.28	±	0.03	0.73	±	0.01	1.01	±	0.04	0.27	±	0.03	0.73	±	0.01	1.00	±	0.04
10232	Farmed trout	0.40	±	0.03	0.82	±	0.01	1.22	±	0.05	0.40	±	0.03	0.82	±	0.01	1.22	±	0.05
Average	Farmed trout	0.28	±	0.02	0.78	±	0.02	1.06	±	0.04	0.28	±	0.02	0.78	±	0.02	1.06	±	0.04

Table 10a. List of herring samples obtained during 2003-04

Appendix 2

Product as described	Sample code	FSA Ref No	Country of origin	Brand	Retailer	Date purchased	Best before date
Herring	9075	961 BJ	-	-	Morrisons, Pendle Street, Nelson, Lancashire, BB9 7UZ	22-Sep-03	24-Sep-03
Herring, cleaned	9076	964 BJ	-	-	ASDA, Molineux Way, Waterloo Road, Wolverhampton, WV1 4DE	18-Sep-03	19-Sep-03
Herring	9077	965 BJ	-	-	Safeway, Basingstoke Road, Reading, Berkshire, RG2 0HB	18-Sep-03	21-Sep-03
Herring	9078	966 BJ	-	-	Morrisons, Black Country Route, Bilston, Wolverhampton, West Midlands, WV14 0DZ	20-Sep-03	24-Sep-03
Herring	9079	967 BJ	-	-	Safeway, Basingstoke Road, Reading, Berkshire, RG2 0HB	19-Sep-03	22-Sep-03
Herring	9080	968 BJ	-	-	Tesco, Mansell Way, Horwich, Bolton, Lancashire, BL6 6JS	4-Sep-03	5-Sep-03
Herring, whole	9081	973 BJ	-	-	Tesco, Fishbourne Road, Chichester, West Sussex, PO19 3JT	16-Sep-03	17-Sep-03
Herring, cleaned	9082	974 BJ	-	-	Tesco, Towngate Retail Park, Birmingham Road, Dudley, West Midlands, DY1 4RP	20-Sep-03	21-Sep-03
Herring, cleaned	9084	978 BJ	North east Atlantic	-	ASDA, Molineux Way, Waterloo Road, Wolverhampton, WV1 4DE	19-Aug-03	21-Aug-03
Herring, whole	9085	979 BJ	-	Asda Cleaned Herring	ASDA, Holmers Farm Way, Cressex, Nr High Wycombe, Bucks, HP12 4NU	8-Sep-03	10-Sep-03
Herring, whole	9086	981 BJ	-	-	Safeway, Priory Bridge Road, Taunton, Somerset, TA1 1DX	16-Sep-03	18-Sep-03
Herring, whole	9087	983 BJ	-	-	Waitrose, 1332 Stratford Road, Hall Green, Birmingham, West Midlands, B28 9EF	6-Sep-03	-
Herring, whole	9088	984 BJ	-	-	Tesco, Mansell Way, Horwich, Bolton, Lancashire, BL6 6JS	23-Sep-03	24-Sep-03
Herring	9089	985 BJ	-	-	Morrisons, Penistone Road, Waterloo, Huddersfield, West Yorkshire, HD5 8QW	8-Sep-03	10-Sep-03
Herring	9090	987 BJ	-	-	Morrisons, Railway Road, Blackburn, Lancashire, BB1 5AZ	29-Sep-03	31-Aug-03
Herring	9091	991 BJ	-	-	Bolton Market, Knowsley Street, Bolton, Lancashire, BL1 2AR	23-Sep-03	24-Sep-03

Table 10 a. List of herring samples obtained during 2003-04 (continued)

Appendix 2

Product as described	Sample code	FSA Ref No	Country of origin	Brand	Retailer	Date purchased	Best before date
Herring	9092	992 BJ	-	-	Blackburn with Darwen Markets, Ainsworth Street, Blackburn, Lancashire, BB1 6AD	23-Sep-03	-
Herring	9093	995 BJ	-	-	Chorley Fisheries, Chorley Market, Cleveland St, Chorley, Lancashire, PR7 1DA	23-Sep-03	24-Sep-03
Herring	9135	997 BJ	-	-	Phillip Martin, Wolverhampton Indoor Market, School Road, Wolverhampton, West Midlands, WV3 0SF	30-Aug-03	-
Herring	9136	999 BJ	-	-	R J Sands, Bilston Indoor Market, Bilston, Wolverhampton, West Midlands, WV14 0EH	6-Sep-03	-
Herring, filleted	9094	1002 BJ	-	-	R J Sands, Bilston Indoor Market, Bilston, Wolverhampton, West Midlands, WV14 0EH	13-Sep-03	-
Herring	9095	1004 BJ	-	-	Barrett Brothers, 25 Market street, Crewkerne, Somerset , TA18 7JG	25-Sep-03	-
Herring	9103	1005 BJ	-	-	The Fishmonger, 107a High Street, Honiton, Devon, EX14 1PE	25-Sep-03	-
Herring	9096	1007 BJ	-	-	T White & Son, Fish Merchants of Lowestoft, Thursday Market, Market Place, Newbury, Berkshire, NR32 1HS	18-Sep-03	-
Herring, whole	9097	1008 BJ	-	-	Tesco Extra, Napier Road, Reading, Berkshire, RG1 8DF	12-Sep-03	13-Sep-03
Herring, whole, not filleted	9098	1012 BJ	-	Tesco Whole Herring	Tesco, Kingsway Retail Park, Dundee, DD3 8QB	21-Aug-03	-
Herring, whole	9099	1013 BJ	-	-	Tesco, Wrekin Retail Park, Arleston, Telford, Shropshire, TF1 2DE	22-Sep-03	23-Sep-03
Herring	9100	1015 BJ	-	-	Safeway, 60 Westgate, Otley, West Yorkshire, LS21 3AS	22-Sep-03	23-Sep-03
Herring, whole	9101	1016 BJ	-	-	Tesco, Towngate Retail Park, Birmingham Road, Dudley, West Midlands, DY1 4RP	20-Sep-03	21-Sep-03
Herring	9102	1020 BJ	-	-	Walter Ewing, 124 Shankhill Road, Belfast, County Antrim, N.I., BT13 2DB	23-Sep-03	-

Table 10b. Concentrations (ng WHO-TEQ/kg fresh weight) of dioxins and dioxin-like PCBs in herring samples obtained during 2003-04

Sample code	Species	Concentrations (ng WHO-TEQ/kg fresh weight)																	
		Upper bound									Lower bound								
		Dioxins			PCBs			DX+PCBs			Dioxins			PCBs			DX+PCBs		
9075	Herring	1.40	±	0.08	1.55	±	0.05	2.95	±	0.16	1.40	±	0.08	1.54	±	0.02	2.94	±	0.14
9076	Herring	1.87	±	0.11	1.97	±	0.06	3.84	±	0.12	1.87	±	0.10	1.94	±	0.06	3.81	±	0.13
9077	Herring	1.71	±	0.09	1.90	±	0.06	3.61	±	0.20	1.71	±	0.10	1.88	±	0.06	3.59	±	0.15
9078	Herring	1.06	±	0.07	2.12	±	0.05	3.18	±	0.25	1.06	±	0.06	2.08	±	0.05	3.14	±	0.15
9079	Herring	2.72	±	0.14	2.71	±	0.05	5.43	±	0.15	2.72	±	0.14	2.69	±	0.05	5.41	±	0.27
9080	Herring	0.80	±	0.05	0.80	±	0.04	1.60	±	0.11	0.80	±	0.05	0.78	±	0.01	1.58	±	0.07
9081	Herring	1.20	±	0.08	1.44	±	0.06	2.64	±	0.12	1.19	±	0.07	1.43	±	0.06	2.62	±	0.13
9082	Herring	1.63	±	0.09	1.73	±	0.06	3.36	±	0.12	1.63	±	0.09	1.70	±	0.06	3.33	±	0.15
9084	Herring	1.12	±	0.08	1.38	±	0.05	2.50	±	0.10	1.12	±	0.07	1.35	±	0.05	2.47	±	0.13
9085	Herring	0.87	±	0.06	0.82	±	0.04	1.69	±	0.09	0.87	±	0.06	0.81	±	0.04	1.68	±	0.10
9086	Herring	1.12	±	0.08	2.21	±	0.09	3.33	±	0.18	1.12	±	0.07	2.16	±	0.09	3.28	±	0.16
9087	Herring	0.93	±	0.07	0.89	±	0.06	1.82	±	0.19	0.93	±	0.07	0.86	±	0.02	1.79	±	0.12
9088	Herring	2.35	±	0.12	2.59	±	0.07	4.94	±	0.10	2.35	±	0.12	2.56	±	0.07	4.91	±	0.20
9089	Herring	1.46	±	0.09	3.58	±	0.15	5.04	±	0.31	1.46	±	0.09	3.54	±	0.15	5.00	±	0.25
9090	Herring	1.13	±	0.08	1.22	±	0.07	2.35	±	0.19	1.13	±	0.08	1.19	±	0.02	2.32	±	0.15
9091	Herring	0.91	±	0.05	1.15	±	0.05	2.06	±	0.09	0.91	±	0.06	1.12	±	0.02	2.03	±	0.11
9092	Herring	1.05	±	0.06	1.29	±	0.06	2.34	±	0.17	1.05	±	0.06	1.26	±	0.02	2.31	±	0.12
9093	Herring	1.07	±	0.07	1.26	±	0.06	2.33	±	0.19	1.07	±	0.06	1.23	±	0.02	2.30	±	0.12
9135	Herring	0.80	±	0.06	0.93	±	0.04	1.73	±	0.16	0.80	±	0.06	0.91	±	0.04	1.71	±	0.10
9136	Herring	0.83	±	0.06	0.81	±	0.04	1.64	±	0.20	0.83	±	0.05	0.79	±	0.04	1.62	±	0.09
9094	Herring	1.79	±	0.10	1.91	±	0.09	3.70	±	0.18	1.79	±	0.10	1.89	±	0.03	3.68	±	0.12
9095	Herring	1.81	±	0.10	2.02	±	0.10	3.83	±	0.19	1.81	±	0.10	1.99	±	0.03	3.80	±	0.13
9103	Herring	1.02	±	0.06	1.20	±	0.04	2.22	±	0.10	1.02	±	0.06	1.18	±	0.04	2.20	±	0.10
9096	Herring	2.58	±	0.16	6.89	±	0.15	9.47	±	0.31	2.58	±	0.14	6.82	±	0.15	9.40	±	0.29
9097	Herring	2.07	±	0.13	2.18	±	0.06	4.25	±	0.19	2.07	±	0.11	2.15	±	0.06	4.22	±	0.17
9098	Herring	0.69	±	0.05	0.59	±	0.04	1.28	±	0.09	0.69	±	0.05	0.58	±	0.04	1.27	±	0.09
9099	Herring	1.88	±	0.11	2.19	±	0.07	4.07	±	0.17	1.88	±	0.11	2.16	±	0.07	4.04	±	0.17
9100	Herring	1.91	±	0.12	2.04	±	0.07	3.95	±	0.19	1.91	±	0.11	2.02	±	0.07	3.93	±	0.17
9101	Herring	1.78	±	0.10	1.96	±	0.07	3.74	±	0.16	1.78	±	0.10	1.94	±	0.07	3.72	±	0.16
9102	Herring	1.87	±	0.12	2.35	±	0.08	4.22	±	0.20	1.87	±	0.10	2.31	±	0.08	4.18	±	0.18
Average	Herring	1.43	±	0.09	1.84	±	0.06	3.27	±	0.16	1.43	±	0.08	1.81	±	0.05	3.24	±	0.15

Table 11a. List of mackerel samples obtained during 2003-04

Appendix 2

Product as described	Sample code	FSA Ref No	Country of origin	Brand	Retailer	Date purchased	Best before date
Mackerel, fresh fillets	9913	0700 VE	-	-	Mr. Fish, Bullring Indoor Market, Edgbaston Street, Birmingham, West Midlands, B5 4RQ	1-Jul-03	
Mackerel	9915	0676 VE	-	-	Marks & Spencer, The Meadows, Marshall Road, College Town, Sandhurst, Berkshire, GU47 0FD	1-Aug-03	8-Nov-03
Mackerel	10699	0690 VE	-	-	Safeway, High Wycombe, Buckinghamshire, HP13 5XX	1-Sep-03	
Mackerel	10700	0684 VE	-	-	Waitrose, Exeter Vale Shopping Centre, Russel Way, Exeter, Devon, EX2 7EZ	1-Sep-03	
Mackerel	10702	0709 VE	-	-	Tesco, Friars Park, Carmarthen, Dyfed, SA31 3AN	1-Aug-03	2-Nov-03
Mackerel	10703	0669 VE	-	-	ASDA, Hyndburn Rd, Accrington, Lancashire, BB5 1QA	1-Jul-03	4-Nov-03
Mackerel, whole	10704	0701 VE	-	-	A. J. Barlow, Bullring Indoor Market, Edgbaston Street, Birminham, West Midlands, B5 4RQ	1-Sep-03	
Mackerel	10705	0686 VE	-	-	Morrisons, Central Drive, Morecambe, Lancashire, LA4 4DW	1-Jul-03	10-Oct-03
Mackerel, fillets	10707	0692 VE	-	-	Dockside Fish Ltd, Dock Street, Fleetwood, Lancashire, FY7 6NU	1-Aug-03	14-Nov-03
Mackerel, fillets	10708	0711 VE	-	-	Raymond Rees & Son, Unit 11, New Market, Carmarthen, Dyfed, SA31 1QY	1-Sep-03	5-Nov-03
Mackerel	10709	0697 VE	-	-	Jim Gough Ltd, 8-9 Upper Street, Tettenhall, Wolverhampton, West Midlands, WV6 8QQ	1-Sep-03	
Mackerel	10711	0661 VE	-	-	Sainsbury's, Kinsey Road, Ellesmere Port, Merseyside, CH65 9HN	1-Aug-03	8-Oct-03
Mackerel	10712	0705 VE	-	-	Barrett Brothers, 25 Market street, Crewkerne, Somerset , TA18 7JU	1-Sep-03	
Mackerel	10713	0691 VE	-	-	Dockside Fish Ltd, Dock Street, Fleetwood, Lancashire, FY7 6NU	1-Jul-03	10-Oct-03
Mackerel	10714	0716 VE	-	-	ASDA, Kingsway Retail Park, Dundee, DD3 8QB	1-Sep-03	31-Jan-04

Table 11a. List of mackerel samples obtained during 2003-04 (continued)

Appendix 2

Product as described	Sample code	FSA Ref No	Country of origin	Brand	Retailer	Date purchased	Best before date
Mackerel, whole	10715	0671 VE	-	-	Tesco Stores Ltd Silver Street, Brownhills Walsal West Midlands, WS8 6DZ	1-Jul-03	
Mackerel	10716	0683 VE	-	-	Morrisons, Spring Hill, Wellington, Telford, Shropshire, TF1 1RP	1-Jul-03	5-Oct-03
Mackerel	10706	0688 VE	-	-	Morrisons, Black Country Route, Bilston, Wolverhampton, West Midlands, DB8 9AX	1-Jul-03	
Mackerel	10710	0717 VE	-	-	ASDA, Kingsway Retail Park, Dundee, DD3 8QB	1-Aug-03	20-Feb-04
Mackerel	10717	0708 VE	-	-	Safeway's, Newport, Isle of White, PO30 1JQ	1-Aug-03	
Mackerel	10793	0699 VE	-	-	Phillip Martin, Wolverhampton Indoor Market, School Road, Wolverhampton, West Midlands, WV3 0SF	1-Aug-03	
Mackerel	10798	0665 VE	-	-	Sainsbury's, Bagshot Road, Ringmead, Bracknell, Berkshire, RG12 7SS	1-Sep-03	4-Feb-04
Mackerel	10799	0696 VE	-	-	Bury Fish Market, BL9 0BD	1-Sep-03	8-Jan-04
Mackerel	10800	0678 VE	-	-	ASDA, Woodhall Road, Bloxwich, West Midlands, WS3 3JR	1-Sep-03	
Mackerel	10801	0663 VE	-	-	Sainsbury's, Telford Forge Retail Park, Colliersway, Telford, Shropshire, TF3 4AG	1-Sep-03	12-Dec-03
Mackerel	10802	0693 VE	-	-	Threlfall's Fish stall, Accrington Market, Blackburn Road, Accrington, Lancashire, BB5 0AE	1-Jul-03	
Mackerel	10803	0682 VE	-	-	Waitrose, 45-53 The Broadway, Thatcham, Berkshire, RG19 3HN	1-Sep-03	
Mackerel	10804	0666 VE	-	-	Sainsbury's, Kings Road, Newbury, Berkshire, RG14 5RB	1-Sep-03	9-Jan-04
Mackerel	10831	0719 VE	-	-	Tesco, 2 Knocknagoney Road, Belfast, BT4 2PW	1-Jul-03	10-Nov-03
Mackerel	11028	0695 VE	-	-	Bury Fish Market, BL9 0BD	1-Jul-03	

Table 11b. Concentrations (ng WHO-TEQ/kg fresh weight) of dioxins and dioxin-like PCBs in mackerel samples obtained during 2003-04

Appendix 2

Sample code	Species	Concentrations (ng WHO-TEQ/kg fresh weight)																	
		Upper bound									Lower bound								
		Dioxins			PCBs			DX+PCBs			Dioxins			PCBs			DX+PCBs		
9913	Mackerel	0.17	±	0.04	0.40	±	0.02	0.57	±	0.05	0.16	±	0.05	0.39	±	0.01	0.55	±	0.06
9915	Mackerel	0.55	±	0.06	1.50	±	0.02	2.05	±	0.09	0.55	±	0.07	1.50	±	0.02	2.05	±	0.09
10699	Mackerel	0.33	±	0.03	0.91	±	0.02	1.24	±	0.05	0.33	±	0.04	0.90	±	0.02	1.23	±	0.05
10700	Mackerel	0.50	±	0.05	1.39	±	0.02	1.89	±	0.07	0.50	±	0.06	1.39	±	0.02	1.89	±	0.08
10702	Mackerel	0.27	±	0.03	0.58	±	0.01	0.85	±	0.05	0.26	±	0.04	0.58	±	0.01	0.84	±	0.05
10703	Mackerel	0.33	±	0.04	0.81	±	0.02	1.14	±	0.05	0.33	±	0.04	0.81	±	0.02	1.14	±	0.06
10704	Mackerel	0.42	±	0.03	1.36	±	0.02	1.78	±	0.05	0.42	±	0.04	1.36	±	0.02	1.78	±	0.06
10705	Mackerel	1.29	±	0.10	3.91	±	0.06	5.20	±	0.17	1.29	±	0.09	3.91	±	0.06	5.20	±	0.16
10707	Mackerel	0.83	±	0.07	2.76	±	0.04	3.59	±	0.11	0.83	±	0.08	2.76	±	0.04	3.59	±	0.12
10708	Mackerel	0.27	±	0.04	0.67	±	0.01	0.94	±	0.06	0.27	±	0.05	0.67	±	0.01	0.94	±	0.06
10709	Mackerel	0.55	±	0.06	1.80	±	0.03	2.35	±	0.09	0.55	±	0.06	1.80	±	0.03	2.35	±	0.09
10711	Mackerel	0.27	±	0.04	1.13	±	0.02	1.40	±	0.06	0.26	±	0.05	1.13	±	0.02	1.39	±	0.06
10712	Mackerel	0.55	±	0.06	1.52	±	0.02	2.07	±	0.08	0.54	±	0.05	1.52	±	0.02	2.06	±	0.08
10713	Mackerel	0.30	±	0.04	0.56	±	0.01	0.86	±	0.05	0.30	±	0.05	0.56	±	0.01	0.86	±	0.06
10714	Mackerel	0.25	±	0.06	0.95	±	0.02	1.20	±	0.07	0.24	±	0.03	0.95	±	0.02	1.19	±	0.05
10715	Mackerel	0.25	±	0.04	0.41	±	0.01	0.66	±	0.05	0.25	±	0.04	0.41	±	0.01	0.66	±	0.05
10716	Mackerel	0.14	±	0.03	0.36	±	0.01	0.50	±	0.04	0.12	±	0.01	0.36	±	0.01	0.48	±	0.02
10706	Mackerel	0.78	±	0.06	1.56	±	0.02	2.34	±	0.08	0.78	±	0.05	1.56	±	0.02	2.34	±	0.08
10710	Mackerel	0.18	±	0.03	0.40	±	0.01	0.58	±	0.04	0.18	±	0.03	0.40	±	0.01	0.58	±	0.04
10717	Mackerel	0.46	±	0.04	1.11	±	0.02	1.57	±	0.06	0.46	±	0.04	1.11	±	0.02	1.57	±	0.06
10793	Mackerel	0.26	±	0.04	0.78	±	0.02	1.04	±	0.06	0.26	±	0.04	0.78	±	0.02	1.04	±	0.05
10798	Mackerel	0.53	±	0.05	1.15	±	0.02	1.68	±	0.07	0.53	±	0.05	1.14	±	0.02	1.67	±	0.07
10799	Mackerel	0.17	±	0.04	0.67	±	0.02	0.84	±	0.06	0.15	±	0.02	0.66	±	0.02	0.81	±	0.04
10800	Mackerel	0.24	±	0.03	0.75	±	0.01	0.99	±	0.04	0.24	±	0.03	0.75	±	0.01	0.99	±	0.04
10801	Mackerel	0.64	±	0.06	1.89	±	0.04	2.53	±	0.10	0.64	±	0.06	1.88	±	0.03	2.52	±	0.09
10802	Mackerel	6.91	±	0.44	20.59	±	0.38	27.50	±	0.82	6.90	±	0.48	20.59	±	0.38	27.49	±	0.86
10803	Mackerel	0.22	±	0.04	0.75	±	0.02	0.97	±	0.05	0.22	±	0.04	0.75	±	0.02	0.97	±	0.06
10804	Mackerel	1.43	±	0.10	4.18	±	0.08	5.61	±	0.18	1.43	±	0.09	4.17	±	0.07	5.60	±	0.16
10831	Mackerel	0.60	±	0.06	1.31	±	0.02	1.91	±	0.08	0.59	±	0.06	1.30	±	0.02	1.89	±	0.08
11028	Mackerel	0.21	±	0.02	0.71	±	0.01	0.92	±	0.04	0.21	±	0.02	0.71	±	0.01	0.92	±	0.04
Average	Mackerel	0.66	±	0.06	1.90	±	0.04	2.56	±	0.10	0.66	±	0.06	1.89	±	0.03	2.55	±	0.10

Table 12a. List of organic salmon and rainbow trout samples obtained during 2003-04

Appendix 2

Product as described	Sample code	FSA Ref No	Country of origin	Brand	Retailer	Date purchased	Best before date
Salmon, organic	10617	3002 OS			Waitrose, School Way, Okehampton, Devon	13-May-04	
Salmon, organic	10618	3004 OS	Scotland		E Rawley & Co, 17 East Street, Newquay, Cornwall	11-May-04	
Salmon, organic	10622	3003 OS			The Fishmonger, 107A High Street, Honiton, Devon	6-May-04	
Salmon, whole Irish organic	10968	3001 OS	Ireland		Phillip The Fishmonger, 15 Pannier Market, Tavistock Devon	10-Aug-04	11-Aug-04
Trout, farmed, organic	10231	2625 TD			Tesco, Pinchington Lane, Greenham, Newbury, Berkshire, RG14 7HB	8-Apr-04	8-Apr-04
Trout, farmed, organic	10674	2634 TD			Sainsbury's, Baldovie Road, Claypotts, Dundee, DD4 8UG	16-Jun-04	16-Jun-04
Trout, brown, organic	10697	3008 OT			Waitrose, School Way, Okehampton, Devon, EX20 1WJ	9-Jul-04	9-Jul-04
Trout, whole, organic	10698	3007 OT			S & P Fish, 9 Butchers Row , Barnstable North Devon , EX31 1BW	16-Jul-04	16-Jul-04
Trout, organic	10960	3005 OT			Sainsbury's, Gratton Way, Roundswell, Barnstaple, North Devon, EX31 3NH	1-Jul-04	1-Jul-04
Trout, organic	10961	3006 OT			Tesco, Castle Street Weelington Rd Taunton Somerset, TA1 4EQ	18-Jun-04	18-Jun-04

Table 12b. Concentrations (ng WHO-TEQ/kg fresh weight) of dioxins and dioxin-like PCBs in organic salmon and rainbow trout samples obtained during 2003-04

Appendix 2

Sample code	Species	Concentrations (ng WHO-TEQ/kg fresh weight)																	
		<i>Upper bound</i>									<i>Lower bound</i>								
		Dioxins			PCBs			DX+PCBs			Dioxins			PCBs			DX+PCBs		
10617	Organic salmon	0.62	±	0.04	1.70	±	0.03	2.32	±	0.07	0.62	±	0.04	1.70	±	0.03	2.32	±	0.06
10618	Organic salmon	0.72	±	0.05	1.79	±	0.03	2.51	±	0.08	0.72	±	0.05	1.79	±	0.03	2.51	±	0.08
10622	Organic salmon	0.74	±	0.05	1.99	±	0.03	2.73	±	0.08	0.74	±	0.05	1.99	±	0.03	2.73	±	0.08
10968	Organic salmon	0.42	±	0.03	1.11	±	0.02	1.53	±	0.05	0.42	±	0.03	1.11	±	0.02	1.53	±	0.05
Average	Organic salmon	0.63	±	0.04	1.65	±	0.03	2.27	±	0.07	0.63	±	0.04	1.65	±	0.03	2.27	±	0.07
10231	Organic trout	0.29	±	0.02	0.79	±	0.01	1.08	±	0.03	0.29	±	0.02	0.79	±	0.01	1.08	±	0.03
10674	Organic trout	0.31	±	0.03	0.63	±	0.01	0.94	±	0.05	0.31	±	0.03	0.63	±	0.01	0.94	±	0.04
10697	Organic trout	0.31	±	0.03	0.73	±	0.01	1.04	±	0.04	0.31	±	0.03	0.73	±	0.01	1.04	±	0.04
10698	Organic trout	0.25	±	0.04	0.63	±	0.01	0.88	±	0.05	0.24	±	0.04	0.63	±	0.01	0.87	±	0.05
10960	Organic trout	0.24	±	0.03	0.62	±	0.01	0.86	±	0.05	0.24	±	0.03	0.62	±	0.01	0.86	±	0.05
10961	Organic trout	0.20	±	0.03	0.53	±	0.01	0.73	±	0.04	0.20	±	0.03	0.53	±	0.01	0.73	±	0.04
Average	Organic trout	0.27	±	0.03	0.66	±	0.01	0.92	±	0.04	0.27	±	0.03	0.66	±	0.01	0.92	±	0.04