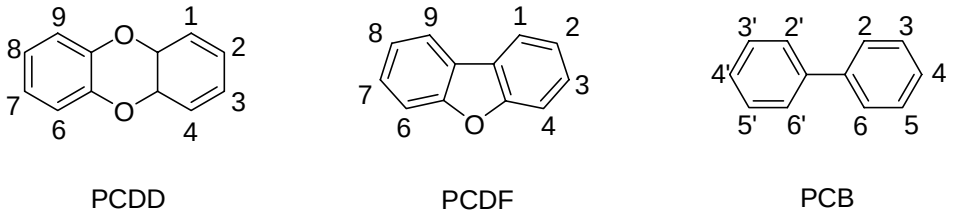
SUPPORTING INFORMATION for "Experimental Study on the Removal of Dioxins and Coplanar PCBs from Fish Oil"

Figure 1. Molecular structures of PCDDs, PCDFs, and cPCBs.



non-*ortho* PCB: There is no chlorine atom at *ortho* position (2, 6, 2', and 6' position).
mono-*ortho* PCB: There is one chlorine atom at *ortho* position.

Table 1. Measuring conditions in the gas chlomatograph mass spectrometer for PCDDs, PCDFs, and cPCBs.

Gas chlomatograph

1, Target compounds: TeCDDs, TeCDFs, PeCDDs, PeCDFs, HxCDDs, HxCDFs

Column type: SP-2331 (Supelco) 0.25 mm i.d. x 60 m, 0.20 µm

Column temperature: 150°C (1.5 min) → (20□/min) → 200□ → (2□/min) → 260°C (26 min)

Column injection port temperature: 250°C

Sample injection method: Splitless (90 s)

Sample injection volume: 2 µl

2, Target compounds: 1,2,3,7,8,9-HxCDF, HpCDDs, OCDD, HpCDFs, OCDF, Coplanar PCBs

Column type: Rh-12MS (INVENTX) 0.25mm i.d. x 60m

Column temperature: 150°C (1 min) → (15□/min) → 210□ → (3□/min) → 300°C (20.3 min)

Column injection port temperature: 250°C

Sample injection method: Splitless (90 s)

Sample injection volume: 2 µl

Mass spectrometer

Resolution: 10000 or more

Electron accelerating voltage: 38 V

Ionization current: 500 μA

Ion source temperature: 260°C

Detection method: SIM method with Lockmass mode

Monitor ion:

	^{12}C		^{13}C	
TeCDDs	319.8965	321.8936	331.9368	333.9339
TeCDFs	303.9016	305.8987	315.9419	317.9389
PeCDDs	355.8546	357.8516	367.8949	365.8978
PeCDFs	339.8597	341.8567	349.9029	351.9
HxCDDs	389.8157	391.8127	401.8559	403.853
HxCDFs	373.8208	375.8178	385.861	387.8581
HpCDDs	423.7769	425.7739	435.8169	437.814
HpCDFs	407.7818	409.7788	419.822	421.8191
OCDD	457.738	459.735	469.7783	471.7753
OCDF	441.7341	443.74	453.784	455.7801

TeCBs	289.9224	291.9194	301.9626	303.9597
PeCBs	325.8804	327.8775	337.9207	339.9178
HxCBs	359.8415	361.8385	371.8817	373.8788
HpCBs	393.8025	395.7995	405.8428	407.8398

Table 2. Molecular weight, observed Kco_2/oil value, and LogKow value of each congener.

Congener	Molecular weight	Partitioning coefficient ($K_{CO_2/oil}$)	LogKow
2,3,7,8-TeCDD	320	0.0026	6.7
1,2,3,7,8-PeCDD	354	0.0013	7.2
1,2,3,4,7,8-HxCDD	388	0.0012	7.6
1,2,3,6,7,8-HxCDD	388	0.0010	7.6
1,2,3,7,8,9-HxCDD	388	0.00087	7.6
1,2,3,4,6,7,8-HpCDD	422	0.00069	8.1
OCDD	456	0.00032	8.5
2,3,7,8-TeCDF	304	0.0021	6.1
1,2,3,7,8-PeCDF	338	0.0016	6.5
2,3,4,7,8-PeCDF	338	0.0014	6.6
1,2,3,4,7,8-HxCDF	372	0.0013	6.9
1,2,3,6,7,8-HxCDF	372	0.0010	6.9
1,2,3,7,8,9-HxCDF	372	0.00076	7.1
2,3,4,6,7,8-HxCDF	372	0.0012	7.0
1,2,3,4,6,7,8-HpCDF	406	0.00085	7.4
1,2,3,4,7,8,9-HpCDF	406	0.00065	7.6
OCDF	440	0.00031	8.0
#81 3,4,4',5-TeCB	292	0.0035	6.3
#77 3,3',4,4'-TeCB	292	0.0038	6.3
#126 3,3',4,4',5-PeCB	326	0.0016	6.9
#123 2',3,4,4',5-PeCB	326	0.0041	6.7
#118 2,3',4,4',5-PeCB	326	0.0034	6.6
#105 2,3,3',4,4'-PeCB	326	0.0030	6.6
#114 2,3,4,4',5-PeCB	326	0.0042	6.7
#169 3,3',4,4',5,5'-HxCB	361	0.00050	7.6
#167 2,3',4,4',5,5'-HxCB	361	0.0023	7.1
#156 2,3,3',4,4',5-HxCB	361	0.0024	7.3
#157 2,3,3',4,4',5'-HxCB	361	0.0018	7.1
#189 2,3,3',4,4',5,5'-HpCB	395	0.0013	7.8

Table 3. Concentrations and TEQs for the PCDD/DFs and cPCBs on the SCE and adsorption process.

		Original fish oil		After SCE treatment			After activated carbon treatment		
Congener	TEF	Concentration	TEQ	Concentration	TEQ	Removal efficiency (%)	Concentration	TEQ	Removal efficiency (%)
		pg/g	pg TEQ/g	pg/g	pg TEQ/g	TEQ base	pg/g	pg TEQ/g	TEQ base
2,3,7,8-TeCDD	1	220	220	29	29	87	ND	0	100
1,2,3,7,8-PeCDD	1	290	290	76	76	74	ND	0	100
1,2,3,4,7,8-HxCDD	0.1	520	52	230	23	56	ND	0	100
1,2,3,6,7,8-HxCDD	0.1	550	55	220	22	60	ND	0	100
1,2,3,7,8,9-HxCDD	0.1	490	49	210	21	57	ND	0	100
1,2,3,4,6,7,8-HpCDD	0.01	550	5.5	320	3.2	42	ND	0	100
OCDD	0.0001	1500	0.15	1300	0.13	13	(9.1)	0.00091	99
2,3,7,8-TeCDF	0.1	310	31	54	5.4	83	(3.1)	0.31	99
1,2,3,7,8-PeCDF	0.05	280	14	64	3.2	77	ND	0	100
2,3,4,7,8-PeCDF	0.5	280	140	92	46	67	ND	0	100
1,2,3,4,7,8-HxCDF	0.1	540	54	210	21	61	(8.3)	0.83	98
1,2,3,6,7,8-HxCDF	0.1	580	58	210	21	64	ND	0	100
1,2,3,7,8,9-HxCDF	0.1	520	52	260	26	50	(11)	1.1	98
2,3,4,6,7,8-HxCDF	0.1	510	51	260	26	49	ND	0	100
1,2,3,4,6,7,8-HpCDF	0.01	590	5.9	370	3.7	37	ND	0	100
1,2,3,4,7,8,9-HpCDF	0.01	500	5.0	370	3.7	26	ND	0	100
OCDF	0.0001	1400	0.14	1200	0.12	14	ND	0	100
Total TeCDD/DFs		530	250	82	34	86	3.1	0.31	100
Total PeCDD/DFs		850	440	230	130	70	ND	0	100
Total HxCDD/DFs		3700	370	940	160	57	19	1.9	99
Total HpCDD/DFs		1600	16	1100	11	35	ND	0	100
Total OCDD/DFs		2900	0.29	2500	0.25	14	9.1	0.00091	100
Total PCDDs + PCDFs		9600	1080	5400	330	69	21	1.9	100
3,4,4',5-TeCB	0.0001	340	0.034	26	0.0026	92	ND	0	100
3,3',4,4'-TeCB	0.0001	1400	0.14	110	0.011	92	(11)	0.0011	99
3,3',4,4',5-PeCB	0.1	430	43	72	7.2	83	ND	0	100
3,3',4,4',5,5'-HxCB	0.01	330	3.3	100	1.0	70	16	0.16	95
2',3,4,4',5-PeCB	0.0001	790	0.079	52	0.0052	93	38	0.0038	95
2,3',4,4',5-PeCB	0.0001	28000	2.8	2100	0.21	93	1300	0.13	95
2,3,3',4,4'-PeCB	0.0001	7700	0.77	780	0.078	90	520	0.052	93
2,3,4,4',5-PeCB	0.0005	640	0.32	52	0.026	92	38	0.019	94
2,3',4,4',5,5'-HxCB	0.00001	2400	0.024	340	0.0034	86	250	0.0025	90
2,3,3',4,4',5-HxCB	0.0005	3100	1.6	560	0.28	82	420	0.21	86
2,3,3',4,4',5'-HxCB	0.0005	1200	0.60	240	0.12	80	130	0.065	89
2,3,3',4,4',5,5'-HpCB	0.0001	740	0.074	230	0.023	69	210	0.021	72
Total TeCBs		1700	0.17	140	0.014	92	11	0.0011	99
Total PeCBs		38000	47	3100	7.5	84	1900	0.36	99
Total HxCBs		7000	5.5	1200	1.4	74	820	0.44	92
Total HpCBs		740	0.074	230	0.023	69	210	0.021	72
Total non-*ortho* cPCBs		2500	46	310	8.2	82	26	0.161	100
Total mono-*ortho* cPCBs		45000	6.2	4300	0.75	88	2900	0.50	92
Total cPCBs		47000	53	4600	9.0	83	2900	0.66	99
Total PCDDs + PCDFs +cPCBs		57000	1100	10000	340	69	2900	2.6	100

ND: not detected

In this experiment, the concentrations of PCDD/DFs and cPCBs for original fish oil were set to lower level than other experiments.