

APPENDIX A
GFAAS CONDITIONS

Appendix A-1 The absorbance of $2.0 \mu\text{g L}^{-1}$ of Cd at the difference pyrolysis temperatures.

Pyrolysis T e m p . (°C)	Absorbance (A.s)				SD	%RSD
	Replicate 1	Replicate 2	Replicate 3	Mean		
400	0.0777	0.0772	0.0786	0.0778	0.0007	0.95
500	0.0768	0.0777	0.0771	0.0772	0.0005	0.59
600	0.0769	0.0755	0.0797	0.0774	0.0022	2.81
700	0.0773	0.0787	0.0774	0.0778	0.0008	1.00
800	0.0746	0.0759	0.0795	0.0767	0.0026	3.34
900	0.0746	0.0771	0.0751	0.0762	0.0010	1.33
1,000	0.0760	0.0767	0.0756	0.0761	0.0006	0.73
1,100	0.0451	0.0539	0.0490	0.0494	0.0044	8.96
1,200	0.0091	0.0131	0.0118	0.0114	0.0021	18.21

Appendix A-2 The absorbance of $2.0 \mu\text{g L}^{-1}$ of Cd at the difference atomization temperatures.

Atomization	Absorbance (A.s)				SD	%RSD
Temp. (°C)	Replicate 1	Replicate 2	Replicate 3	Mean		
1,000	0.0209	0.0219	0.0194	0.0207	0.0013	6.17
1,100	0.0712	0.0728	0.0603	0.0681	0.0068	9.99
1,200	0.0895	0.0910	0.0865	0.0890	0.0023	2.57
1,300	0.0850	0.0798	0.0749	0.0799	0.0051	6.32
1,400	0.0795	0.0763	0.0782	0.0780	0.0016	2.06
1,500	0.0692	0.0780	0.0757	0.0743	0.0046	6.14
1,600	0.0699	0.0686	0.0751	0.0712	0.0034	4.83
1,700	0.0668	0.0664	0.0690	0.0674	0.0014	2.08
1,800	0.0653	0.0634	0.0759	0.0682	0.0067	9.88
1,900	0.0664	0.0651	0.0770	0.0695	0.0065	9.39
2,000	0.0663	0.0674	0.0733	0.0690	0.0038	5.46
2,100	0.0710	0.0702	0.0667	0.0693	0.0023	3.30
2,200	0.0746	0.0751	0.0681	0.0726	0.0039	5.38

Appendix A-3 The absorbance of $50.0 \mu\text{g L}^{-1}$ of Pb at the difference pyrolysis temperatures.

Pyrolysis T e m p . (°C)	Absorbance (A.s)				SD	%RSD
	Replicate 1	Replicate 2	Replicate 3	Mean		
400	0.0899	0.0871	0.0864	0.0878	0.0019	2.12
500	0.0905	0.0904	0.0904	0.0904	0.000	0.03
600	0.0935	0.0918	0.0909	0.0921	0.0013	1.43
700	0.0914	0.0905	0.0907	0.0908	0.0005	0.53
800	0.0912	0.0911	0.0917	0.0913	0.0003	0.37
900	0.0899	0.0926	0.0915	0.0913	0.0014	1.49
1,000	0.0917	0.0892	0.0891	0.0900	0.0015	1.63
1,100	0.0885	0.0906	0.0884	0.0891	0.0012	1.36
1,200	0.0593	0.0652	0.0769	0.0671	0.0090	13.34
1,300	0.0242	0.0266	0.0236	0.0236	0.0033	13.93

Appendix A-4 The absorbance of $50.0 \mu\text{g L}^{-1}$ of Pb at the difference atomization temperatures.

Atomization Temp. (°C)	Absorbance (A.s)			SD	%RSD
	Replicate 1	Replicate 2	Mean		
1,000	0.0014	0.0010	0.0012	0.0003	28.88
1,100	0.0018	0.0020	0.0019	0.0001	7.44
1,200	0.0369	0.0346	0.0358	0.0016	4.56
1,300	0.0966	0.0946	0.0956	0.0014	1.48
1,400	0.0939	0.0877	0.0908	0.0044	4.82
1,500	0.0929	0.0927	0.0928	0.0001	0.13
1,600	0.0862	0.0856	0.0859	0.0004	0.47
1,700	0.0833	0.0834	0.0834	0.0001	0.08
1,800	0.0817	0.0812	0.0815	0.0003	0.41
1,900	0.0805	0.0808	0.0807	0.0001	0.18
2,000	0.0821	0.0809	0.0815	0.0008	0.97
2,100	0.0841	0.0865	0.0853	0.0020	1.99

Appendix A-5 The effect of different matrix modifiers on $4.0 \mu\text{g L}^{-1}$ Cd absorbance.

Modifiers	Absorbance (A.s)				SD	%RSD
	Replicate 1	Replicate 2	Replicate 3	Mean		
No modi.	0.1628	0.1663	0.1713	0.1668	0.0043	2.56
Modi.1	0.1813	0.1926	0.1916	0.1885	0.0063	3.32
Modi.2	0.1755	0.1757	0.1826	0.1779	0.0040	2.27
Modi.3	0.1797	0.1884	0.1922	0.1868	0.0064	3.44

Appendix A-6 The effect of different matrix modifiers on $100.0 \mu\text{g L}^{-1}$ Pb absorbance.

Modifiers	Absorbance (A.s)			SD	%RSD
	Replicate 1	Replicate 2	Mean		
No modi.	0.2323	0.2389	0.2356	0.0050	1.98
Modi.1	0.2292	0.2285	0.2289	0.0004	0.19
Modi.2	0.2214	0.2213	0.2214	0.0001	0.04
Modi.3	0.2365	0.2360	0.2362	0.0003	0.14

Appendix A-7 The absorbance of Cd at the different concentrations. (Linear range)

Cd conc. ($\mu\text{g L}^{-1}$)	Absorbance (A.s)			SD	%RSD
	Replicate 1	Replicate 2	Mean		
0.0	0.0007	0.0005	0.0006	0.0001	23.57
0.1	0.0043	0.0053	0.0048	0.0007	14.73
1.0	0.0600	0.0625	0.0612	0.0018	2.89
2.0	0.1087	0.1058	0.1073	0.0020	1.86
4.0	0.1944	0.1959	0.1952	0.0010	0.53
6.0	0.2782	0.2823	0.2803	0.0029	1.04
8.0	0.3522	0.3705	0.3613	0.0129	3.58
10.0	0.4395	0.3245	0.3820	0.0813	21.28
12.0	0.3884	0.3757	0.3821	0.0090	2.35
14.0	0.4329	0.4088	0.4208	0.0170	4.04
16.0	0.4589	0.4643	0.4616	0.0038	0.83
18.0	0.4939	0.5001	0.4970	0.0044	0.88
20.0	0.5260	0.5558	0.5409	0.0211	3.90
22.0	0.5647	0.5561	0.5604	0.0061	1.09
24.0	0.5750	0.6021	0.5886	0.0192	3.26

Appendix A-8 The absorbance of Pb at the different concentrations. (Linear range)

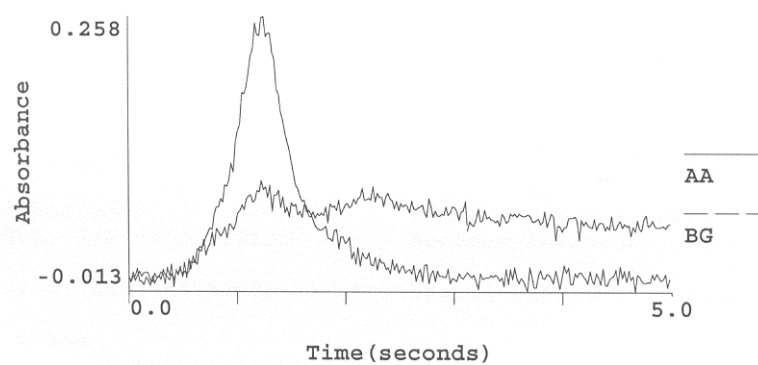
Pb conc. ($\mu\text{g L}^{-1}$)	Absorbance (A.s)			SD	%RSD
	Replicate 1	Replicate 2	Mean		
0.0	0.0002	0.0006	0.0004	0.0001	35.36
0.3	0.0018	0.0014	0.0016	0.0003	17.68
10.0	0.0363	0.0352	0.0358	0.0008	2.13
20.0	0.0601	0.0608	0.0604	0.0005	0.78
40.0	0.1120	0.1122	0.1121	0.0001	0.12
60.0	0.1621	0.1604	0.1613	0.0012	0.76
80.0	0.2071	0.2039	0.2055	0.0023	1.10
100.0	0.2544	0.2576	0.2560	0.0023	0.89
120.0	0.3007	0.3020	0.3014	0.0009	0.30
140.0	0.3319	0.3333	0.3326	0.0010	0.30
160.0	0.3930	0.3837	0.3884	0.0065	1.68
180.0	0.4301	0.4004	0.4153	0.0210	5.06
200.0	0.4394	0.4306	0.4350	0.0062	1.42
220.0	0.4798	0.4874	0.4836	0.0054	1.12
240.0	0.5179	0.5157	0.5168	0.0016	0.31

Appendix A-9 GFAAS operating condition for Cd and Pb
determination (Perkin Elmer AAnalyst 800)

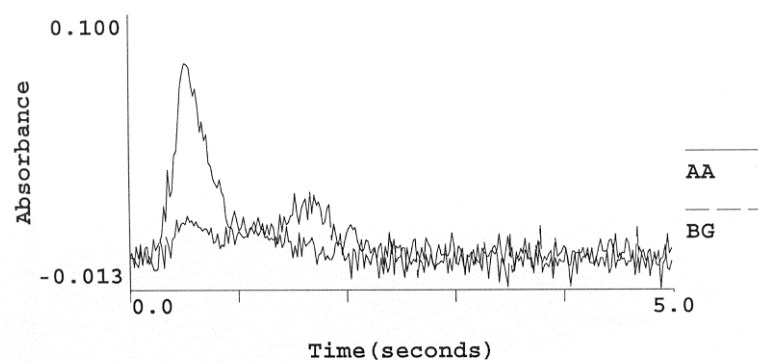
Parameter	Metal	
	Cd	Pb
Wavelength (nm)	228.8	283.3
Slit width (nm)	0.7	0.7
Lamp current (mA)	4	10

Appendix A-10 ICP-OES operating conditions for Cd and Pb determination
in frozen seafood samples

Parameter	Metal	
	Cd	Pb
Wavelength (nm)	228.802	220.353
Plasma flow (L min ⁻¹)	15	0.2
Auxiliary flow (L min ⁻¹)	15	0.2
Nebulizer flow (L min ⁻¹)	0.80	0.80
Power (watts)	1,300	1,300
Plasma view	Axial	Axial
Peristaltic pump flow rate (mL min ⁻¹)	1.50	1.50

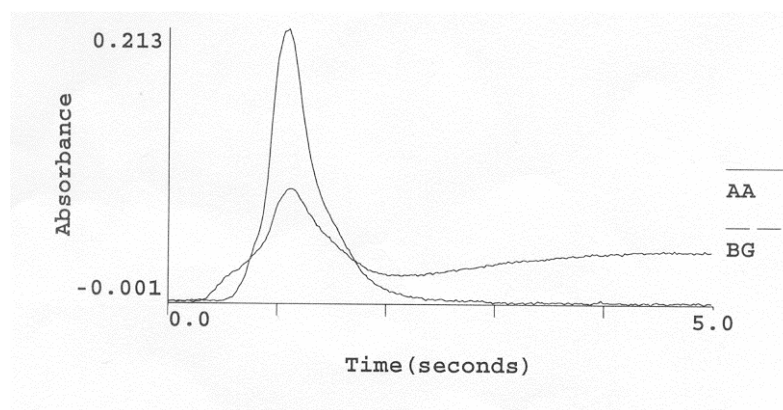


(a)

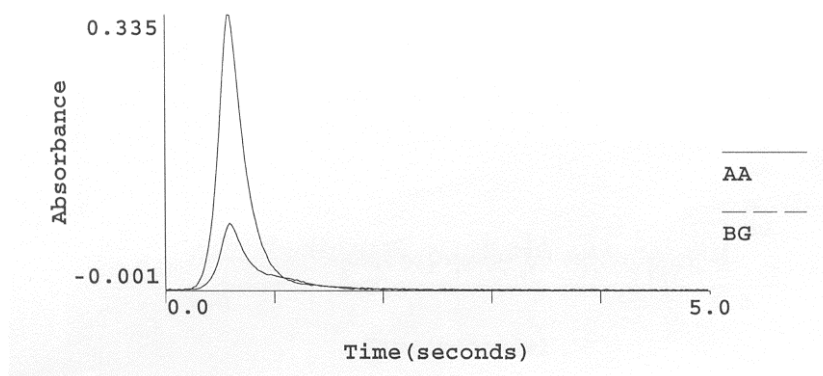


(b)

Appendix A-11 Absorption profile of Cd with (a) and without (b) combine
0.006% $\text{Mg}(\text{NO}_3)_2$ and 1% $\text{NH}_4\text{H}_2\text{PO}_4$ matrix modifier

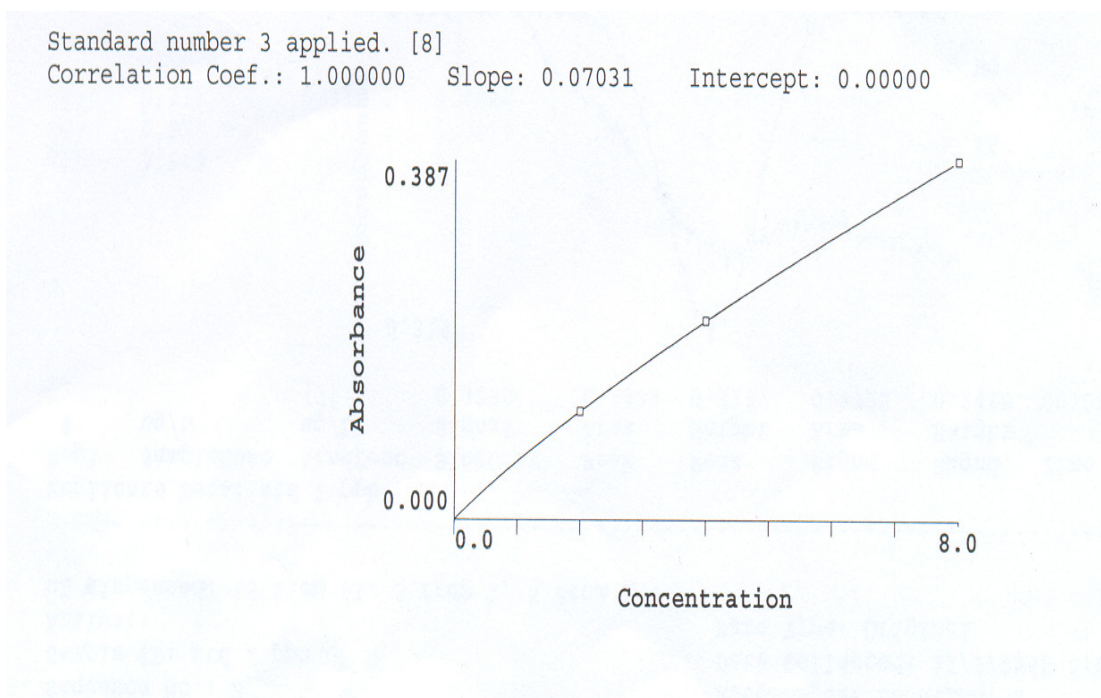


(a)

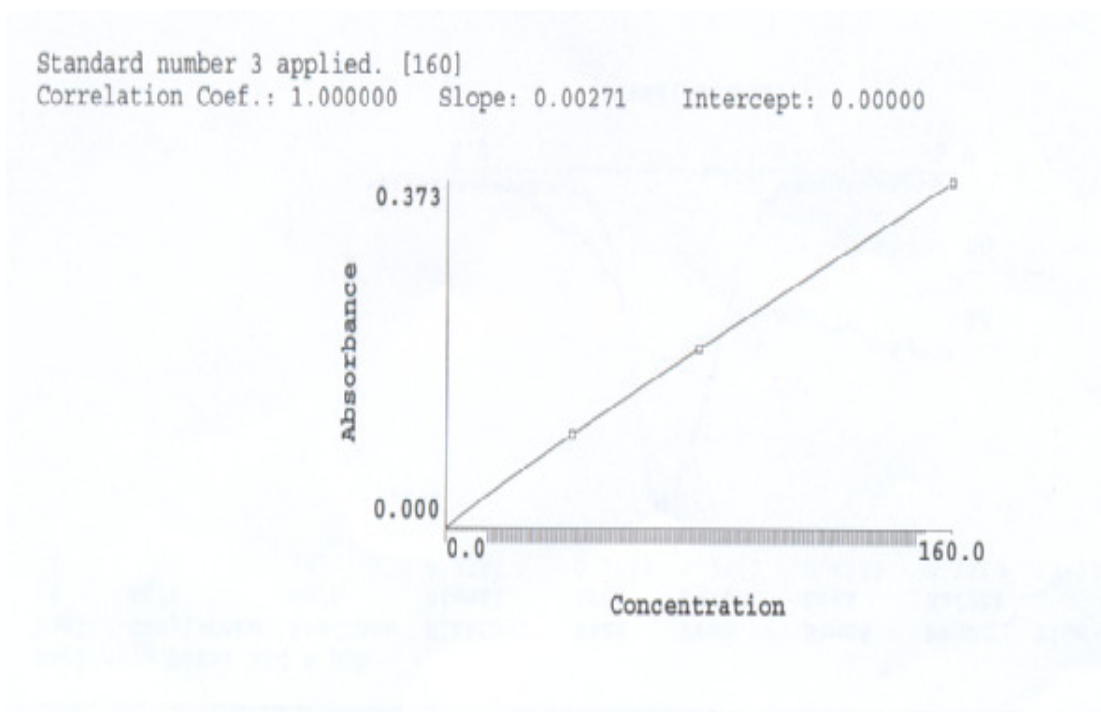


(b)

Appendix A-12 Absorption profile of Pb with (a) and without (b) combine
0.006% $\text{Mg}(\text{NO}_3)_2$ and 1% $\text{NH}_4\text{H}_2\text{PO}_4$ matrix modifier



Appendix A-15 Calibration graph for Cd determination



Appendix A-13 Calibration graph for Pb determination

APPENDIX B
DIGESTION METHOD

Appendix B-1 Analytical results for the determination of trace Cd in the certified reference material (DORM-2) by using hot plate digestion method

Replicate	Cadmium Concentration ($\mu\text{g L}^{-1}$)	%Recovery	mg kg^{-1}
1	1.83	106.40	0.0458
2	1.93	112.20	0.0483
3	1.90	110.47	0.0475
		Mean	0.0472
		SD	0.0013
		%RSD	2.72

Appendix B-2 Analytical results for the determination of trace Pb in the certified reference material (DORM-2) by using hot plate digestion method

Replicate	Lead Concentration ($\mu\text{g L}^{-1}$)	%Recovery	mg kg^{-1}
1	3.08	112.64	0.0769
2	2.60	95.24	0.0640
3	2.98	109.16	0.0745
		Mean	0.0718
		SD	0.0056
		%RSD	7.77

Appendix B-3 Analytical results for the determination of trace Cd in the certified reference material (DORM-2) by using water bath digestion method

Replicate	Cadmium Concentration ($\mu\text{g L}^{-1}$)	%Recovery	mg kg^{-1}
1	1.91	111.05	0.0478
2	1.96	113.95	0.0490
3	1.93	112.40	0.0483
		Mean	0.0484
		SD	0.0006
		%RSD	1.29

Appendix B-4 Analytical results for the determination of trace Pb in the certified reference material (DORM-2) by using water bath digestion method

Replicate	Lead Concentration ($\mu\text{g L}^{-1}$)	%Recovery	mg kg^{-1}
1	2.48	95.38	0.0620
2	2.75	105.77	0.0688
3	2.93	112.69	0.0733
		Mean	0.0680
		SD	0.0046
		%RSD	6.80

Appendix B-5 Analytical results for the determination of trace Cd in the certified reference material (DORM-2) by using dry ashing method

Replicate	Cadmium Concentration ($\mu\text{g L}^{-1}$)	%Recovery	mg kg^{-1}
1	1.74	101.34	0.0436
2	1.83	106.1	0.0456
3	1.85	107.27	0.0461
		Mean	0.0451
		SD	0.0011
		%RSD	2.45

Appendix B-6 Analytical results for the determination of trace Pb in the certified reference material (DORM-2) by using dry ashing method

Replicate	Lead Concentration ($\mu\text{g L}^{-1}$)	%Recovery	mg kg^{-1}
1	2.87	105.13	0.0718
2	2.67	97.80	0.0668
3	2.98	109.16	0.0745
		Mean	0.0710
		SD	0.0032
		%RSD	4.49

APPENDIX C
SOLID PHASE EXTRACTION

Appendix C-1 Effect of pH of sample solution on Cd extraction

pH	Cadmium concentration ($\mu\text{g L}^{-1}$)				SD	%RSD	Initial Conc.	%Recovery
	Rep.1	Rep.2	Rep.3	Mean				
1.0	0.061	0.058	0.055	0.058	0.0031	5.26	0.776	7.50
2.0	0.129	0.139	0.130	0.138	0.0053	4.00	0.776	17.09
3.0	0.318	0.312	0.306	0.312	0.0062	1.99	0.776	40.21
4.0	0.417	0.455	0.480	0.451	0.0317	7.03	0.776	58.12
5.0	0.547	0.531	0.600	0.559	0.0360	6.43	0.776	72.06
6.0	0.840	0.785	0.824	0.816	0.086	3.51	0.776	105.18
7.0	0.731	0.701	0.706	0.712	0.0163	2.29	0.776	91.80
8.0	0.585	0.558	0.534	0.559	0.0255	4.56	0.776	72.06

Appendix C-2 Effect of pH of sample solution on Pb extraction

pH	Lead concentration ($\mu\text{g L}^{-1}$)				SD	%RSD	Initial Conc.	%Recovery
	Rep.1	Rep.2	Rep.3	Mean				
1.0	4.928	5.047	4.788	4.921	0.1296	2.63	10.008	49.17
2.0	7.084	7.187	6.807	7.026	0.1965	2.80	10.008	70.20
3.0	7.424	7.748	7.982	7.718	0.2802	3.63	10.008	77.12
4.0	8.847	9.013	9.323	9.061	0.2416	2.67	10.008	90.54
5.0	9.042	9.586	9.644	9.424	0.3321	3.52	10.008	94.16
6.0	9.840	10.424	10.726	10.330	0.4504	4.36	10.008	103.22
7.0	9.360	9.928	10.280	9.856	0.4642	4.71	10.008	98.48
8.0	5.650	6.140	6.294	6.028	0.3363	5.58	10.008	60.23

Appendix C-3 Effect of amount of 8-hydroxyquinoline (8-HQ) on Cd extraction

8-HQ (mg)	Cd Conc. ($\mu\text{g L}^{-1}$)			SD	%RSD	Initial Conc.	%Recovery
	Rep.1	Rep.2	Mean				
1.00	0.197	0.194	0.195	0.0021	1.09	0.874	22.31
5.00	0.626	0.642	0.634	0.0110	1.74	0.874	72.54
10.00	0.995	0.976	0.985	0.0139	1.41	0.923	106.72
15.00	0.907	0.933	0.920	0.0187	2.03	0.874	105.26
20.00	0.984	0.976	0.980	0.0057	0.58	0.923	106.18
25.00	0.987	1.023	1.005	0.0249	2.48	0.923	108.88
40.00	1.220	1.348	1.284	0.0907	7.06	1.203	106.73

Appendix C-4 Effect of amount of 8-hydroxyquinoline (8-HQ) on Pb extraction

8-HQ (mg)	Pb Conc. ($\mu\text{g L}^{-1}$)			SD	%RSD	Initial Conc.	%Recovery
	Rep.1	Rep.2	Mean				
1.00	8.636	8.860	8.748	0.1584	1.81	27.31	32.03
5.00	28.892	28.988	28.940	0.0679	0.23	27.31	105.97
10.00	25.934	26.102	26.018	0.1188	0.46	25.88	100.84
15.00	26.951	28.281	27.436	0.9405	3.41	25.88	107.04
20.00	35.090	35.194	35.142	0.0735	0.21	34.82	100.92
25.00	25.342	25.514	25.428	0.1216	0.48	24.29	104.69
40.00	21.348	21.452	21.400	0.0735	0.34	19.54	109.52

Appendix C-5 Effect of nitric acid concentration on Cd extraction

HNO ₃ Conc.(M)	Cd Conc. ($\mu\text{g L}^{-1}$)			SD	%RSD	Initial Conc.	%Recovery
	Rep.1	Rep.2	Mean				
0.1	0.263	0.241	0.252	0.0156	6.17	0.874	28.83
0.3	0.614	0.660	0.637	0.0322	5.06	0.874	72.88
0.5	0.762	0.830	0.796	0.0481	6.04	0.874	91.08
0.7	0.789	0.852	0.820	0.0447	5.45	0.874	93.84
1.0	0.947	0.904	0.926	0.0304	3.28	0.874	105.93
2.0	0.984	0.914	0.949	0.0495	5.22	0.874	108.58

Appendix C-6 Effect of nitric acid concentration on Pb extraction

HNO ₃ Conc.(M)	Pb Conc. ($\mu\text{g L}^{-1}$)			SD	%RSD	Initial Conc.	%Recovery
	Rep.1	Rep.2	Mean				
0.1	7.992	8.984	8.488	0.7014	8.26	15.82	53.65
0.3	13.180	13.404	13.292	0.1584	1.19	15.82	84.02
0.5	15.518	14.966	15.242	0.3903	2.56	15.82	96.35
0.7	15.081	15.473	15.277	0.2772	1.81	15.82	96.57
1.0	15.800	15.896	15.848	0.0679	0.43	15.82	100.18
2.0	15.824	16.178	16.001	0.2506	1.57	15.82	101.14

Appendix C-7 Effect of EDTA concentration on Cd extraction

EDTA Conc. (M)	Cd Conc. ($\mu\text{g L}^{-1}$)			SD	%RSD	Initial Conc.	%Recovery
	Rep.1	Rep.2	Mean				
0.1	0.013	0.015	0.014	0.0014	10.10	0.874	1.60
0.3	0.017	0.019	0.018	0.0014	7.86	0.874	2.06
0.5	0.043	0.047	0.045	0.0028	6.29	0.874	5.15
0.7	0.398	0.438	0.418	0.0283	6.77	0.874	47.83
1.0	0.411	0.443	0.427	0.0226	5.30	0.874	48.86

Appendix C-8 Effect of EDTA concentration on Pb extraction

EDTA Conc. (M)	Pb Conc. ($\mu\text{g L}^{-1}$)			SD	%RSD	Initial Conc.	%Recovery
	Rep.1	Rep.2	Mean				
0.1	0.231	0.257	0.244	0.0184	7.53	15.82	1.54
0.3	0.249	0.289	0.269	0.0283	10.51	15.82	1.70
0.5	0.374	0.342	0.358	0.0226	6.32	15.82	2.26
0.7	0.887	1.019	0.953	0.0933	9.79	15.82	6.02
1.0	1.044	0.986	1.015	0.0410	4.04	15.82	6.42

Appendix C-9 Effect of nitric acid volume on Cd extraction

HNO ₃ Vol. (mL)	Cd Conc. ($\mu\text{g L}^{-1}$)			SD	%RSD	Initial Conc.	%Recovery
	Rep.1	Rep.2	Mean				
3.0	0.116	0.124	0.120	0.0057	4.71	1.037	11.57
5.0	1.106	1.009	1.058	0.0687	6.50	1.037	102.01
8.0	1.017	1.063	1.040	0.0325	3.13	1.037	100.29
10.0	1.076	1.144	1.110	0.0481	4.33	1.037	107.04
15.0	1.015	0.993	1.004	0.0156	1.55	0.980	102.45
20.0	1.215	1.195	1.205	0.0141	1.17	1.037	116.20

Appendix C-10 Effect of nitric acid volume on Pb extraction

HNO ₃ Vol. (mL)	Pb Conc. ($\mu\text{g L}^{-1}$)			SD	%RSD	Initial Conc.	%Recovery
	Rep.1	Rep.2	Mean				
3.0	2.578	2.700	2.639	0.0863	3.27	22.01	11.99
5.0	22.496	22.568	22.532	0.0509	0.23	22.01	102.37
8.0	21.988	22.592	22.290	0.4271	1.92	22.01	101.27
10.0	23.143	24.665	23.904	1.0762	4.50	22.01	108.61
15.0	20.538	19.548	20.043	0.7000	3.49	19.73	101.59
20.0	21.985	22.847	22.416	0.6095	2.72	22.01	101.84

APPENDIX D
ANALYTICAL PERFORMANCES

Appendix D-1 Maximum capacities of 10.00 mg 8-hydroxyquinoline modified octadecyl silica membrane disks for Cd and Pb extraction.

Metals	Maximum concentration ($\mu\text{g L}^{-1}$)				SD	%RSD
	Rep.1	Rep.2	Rep.3	Mean		
Cd	30.08	34.70	27.22	30.67	3.77	12.31
Pb	158.74	166.96	180.76	168.82	11.13	6.59

Appendix D-2 Maximum sample volume passed through the 10.00 mg 8-hydroxyquinoline modified octadecyl silica membrane disks for Cd and Pb extraction in this study.

Sample volume (mL)	%Recovery		Eluent volume (mL)	Preconcentration factor
	Cd	Pb		
50	118.72	104.4	5	10
100	104.55	89.73	5	20

* Preconcentration factor = Sample volume / Eluent volume

Appendix D-3 Effect of coexist ions interference on Cd extraction

Replicate	Cd absorbance (A.s)	
	Added ions	No add ions
1	0.1264	0.1216
2	0.1171	0.1244
3	0.1170	0.1198
Mean	0.1202	0.1219
SD	0.0054	0.0023
%RSD	4.49	1.90

Appendix D-4 Effect of coexist ions interference on Pb extraction

Replicate	Pb absorbance (A.s)	
	Added ions	No add ions
1	0.0929	0.1089
2	0.0973	0.1090
3	0.1013	0.1007
Mean	0.0971	0.1062
SD	0.0042	0.0048
%RSD	4.32	4.49

Appendix D-5 The absorbance of Cd on standard addition curve.

Sample	Cd absorbance (A.s)			SD	%RSD
	Rep.1	Rep.2	Mean		
Sample	0.2848	0.2877	0.2863	0.0021	0.72
Sample + Cd 2 ppb	0.3653	0.3661	0.3657	0.0006	0.15
Sample + Cd 4 ppb	0.4491	0.4595	0.4543	0.0074	1.62
Sample + Cd 8 ppb	0.5716	0.5831	0.5774	0.0081	1.41
		R ²	0.9928		
		Slope	0.0364		

Appendix D-6 The absorbance of Cd on calibration curve.

Sample	Cd absorbance (A.s)			SD	%RSD
	Rep.1	Rep.2	Mean		
Sample	0.0000	0.0000	0.0000	0.0000	0.00
Cd 2 ppb	0.1038	0.1058	0.1046	0.0014	1.35
Cd 4 ppb	0.2019	0.2009	0.2014	0.0007	0.35
Cd 8 ppb	0.3941	0.4005	0.3973	0.0045	1.14
		R ²	0.9998		
		Slope	0.0495		

Appendix D-7 The absorbance of Pb on standard addition curve.

Sample	Pb absorbance (A.s)			SD	%RSD
	Rep.1	Rep.2	Mean		
Sample	0.2238	0.2278	0.2258	0.0028	1.25
Sample + Pb 40 ppb	0.3020	0.3095	0.3058	0.0053	1.73
Sample + Pb 80 ppb	0.3850	0.3952	0.3901	0.0072	1.85
Sample + Pb 160 ppb	0.5054	0.5030	0.5042	0.0017	0.34
		R ²	0.9901		
		Slope	0.0017		

Appendix D-8 The absorbance of Pb on calibration curve

Sample	Pb absorbance (A.s)			SD	%RSD
	Rep.1	Rep.2	Mean		
Sample	0.0000	0.0000	0.0000	0.0000	0.00
Pb 40 ppb	0.0964	0.0980	0.0972	0.0011	1.16
Pb 80 ppb	0.2011	0.1995	0.2003	0.0011	0.56
Pb 160 ppb	0.3815	0.3823	0.3819	0.0006	0.15
		R ²	0.9993		
		Slope	0.0024		

Appendix D-9 Recovery test for the studied method using $1.0 \mu\text{g L}^{-1}$ Cd and $20.0 \mu\text{g L}^{-1}$ Pb standard solution (Preconcentration 5 times).

Experimental	Cd concentration ($\mu\text{g L}^{-1}$)			SD	%RSD	%Recovery
	Rep.1	Rep.2	Mean			
1	5.053	5.077	5.065	0.0170	0.34	103.37
2	5.189	5.251	5.22	0.0438	0.84	106.53
3	4.888	4.898	4.893	0.0071	0.14	99.86
4	5.051	5.061	5.056	0.0071	0.14	103.18

Appendix D-10 Recovery test for the studied method using $1.0 \mu\text{g L}^{-1}$ Cd and $20.0 \mu\text{g L}^{-1}$ Pb standard solution (Preconcentration 5 times).

Experimental	Pb concentration ($\mu\text{g L}^{-1}$)			SD	%RSD	%Recovery
	Rep.1	Rep.2	Mean			
1	108.4	109.8	109.1	0.9899	0.91	107.65
2	103.6	105.2	104.4	1.1214	1.08	103.01
3	119.0	117.8	118.4	0.8485	0.72	116.8
4	93.9	92.9	93.4	0.7071	0.76	92.15
5	100.7	103.1	101.9	1.6971	1.67	100.54

Appendix D-11 Recovery test for the studied method using seafood sample spiked $1.0 \mu\text{g L}^{-1}$ Cd and $20.0 \mu\text{g L}^{-1}$ Pb solution (Preconcentration 5 times).

Experimental	Cd concentration ($\mu\text{g L}^{-1}$)			SD	%RSD	%Recovery
	Rep.1	Rep.2	Mean			
1	6.994	7.626	7.310	0.4469	6.11	106.17

Appendix D-12 Recovery test for the studied method using seafood sample spiked $1.0 \mu\text{g L}^{-1}$ Cd and $20.0 \mu\text{g L}^{-1}$ Pb solution (Preconcentration 5 times).

Experimental	Pb concentration ($\mu\text{g L}^{-1}$)			SD	%RSD	%Recovery
	Rep.1	Rep.2	Mean			
1	101.73	109.19	105.46	5.2750	5.00	105.45

APPENDIX E
STATISTICAL ANALYSIS

Appendix E-1 Statistical evaluation for coexist ion interference for Cd

(Paired-Student t-test)

Paired Sample Statistics

Sample	Absorbance Mean	N	Std.Deviation	Std. Error Mean
With ions	0.1202	3	0.0054	0.0031
Without ions	0.1219	3	0.0023	0.0013

Paired Samples Correlations

Sample	N	Correlation	Sig.
With ions & Without ions	3	-0.115	0.926

Paired Sample Test

Sample	Paired Differences				
	95%Confidence Interval of the difference		t	df	Sig.(2-tailed)(P)
	Lower	Upper			
With-without ions	-0.0170	0.0134	-0.500	2	0.67

Appendix E-2 Statistical evaluation for coexist ion interference for Pb

(Paired-Student t-test)

Paired Sample Statistics

Sample	Absorbance Mean	N	Std.Deviation	Std. Error Mean
With ions	0.0972	3	0.0042	0.0024
Without ions	0.1062	3	0.0047	0.0027

Paired Samples Correlations

Sample	N	Correlation	Sig.
With ions & Without ions	3	-0.846	0.358

Paired Sample Test

Sample	Paired Differences				
	95%Confidence Interval of the difference		t	df	Sig.(2-tailed)(P)
	Lower	Upper			
With-without ions	-0.0304	0.0124	-1.816	2	0.211

Appendix E-3 Statistical evaluations for Cd analysis in frozen seafood samples by
the studied method and ICP-OES

(Paired sample Student t-test)

Paired Sample Statistics

Sample	Absorbance Mean	N	Std.Deviation	Std. Error Mean
ICP-OES	0.013	5	0.018	0.008
GFAAS	0.016	5	0.021	0.009

Paired Sample Test

Sample	Paired Differences				
	95%Confidence Interval of the difference		t	df	Sig.(2-tailed)(P)
	Lower	Upper			
ICP-OES&GFAAS	-0.007	0.002	-1.408	4	0.23

Appendix E-4 Statistical evaluations for Pb analysis in frozen seafood samples by
the studied method and ICP-OES

(Paired sample Student t-test)

Paired Sample Statistics

Sample	Absorbance Mean	N	Std.Deviation	Std. Error Mean
ICP-OES	0.066	5	0.020	0.009
GFAAS	0.062	5	0.037	0.016

Paired Sample Test

Sample	Paired Differences				
	95%Confidence Interval of the difference		t	df	Sig.(2-tailed)(P)
	Lower	Upper			
ICP-OES&GFAAS	-0.023	0.032	0.441	4	0.682

Appendix E-5 Statistical evaluations for comparison between standard addition and calibration method for Cd and Pb analysis

(Two-way ANOVA(F-test)).

Dependent variable : Absorbance

Source	Cd		Pb	
	F	Sig.	F	Sig.
Concentration	4669.200	0.000	6789.282	0.000
Method	13006.513	0.000	11867.049	0.000
Conc. & Method	112.568	0.000	175.019	0.000