

## Supplementary Material

Simultaneous detection of trace As, Hg, Tl, and Pb in biological tissues  
using monochromatic excitation X-ray fluorescence spectrometry

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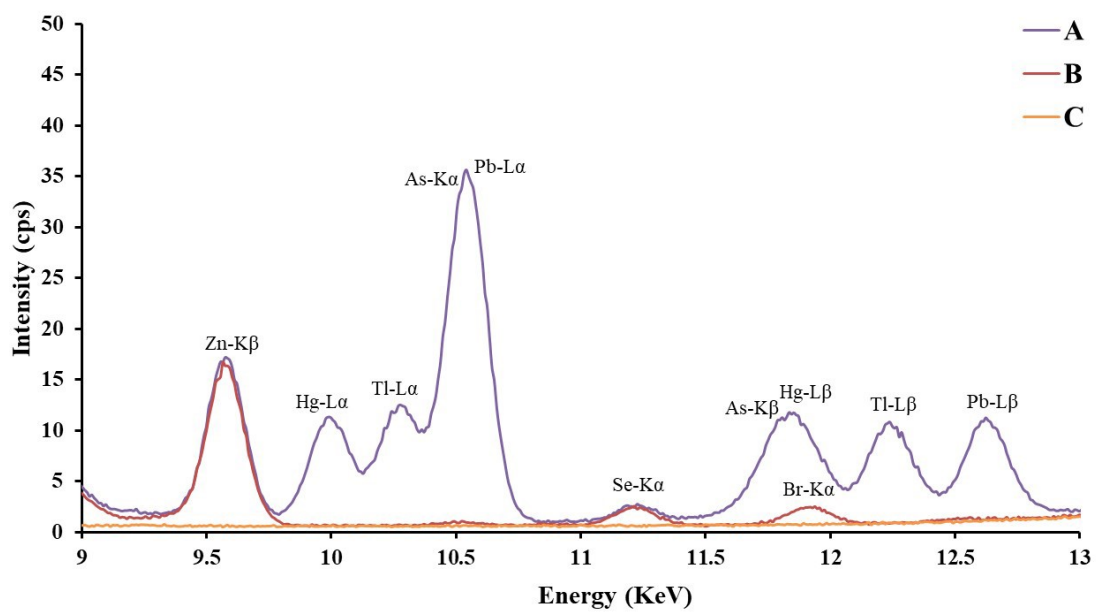


Figure S1 Original X-ray fluorescence spectrum: (A) a spiked tissue sample with 10 ppm of HMs; (B) a tissue sample blank without HMs; (C) a blank spectrum.

Table S1 The concentrations of each element at each sampling point in the homogeneity test

Sampling point number	Concentration ( $\mu\text{g g}^{-1}$ )			
	As	Hg	Tl	Pb
1	10.04	10.77	9.82	10.37
1	10.04	10.43	9.83	10.41
2	9.96	10.25	9.80	10.34
2	9.92	10.26	9.69	10.29
3	10.09	10.41	9.81	10.25
3	10.00	10.40	9.58	10.35
4	10.06	10.26	9.71	10.31
4	10.12	10.58	9.71	10.15
5	10.21	10.44	9.93	10.21
5	10.12	10.50	9.86	10.37
6	10.15	10.31	9.60	10.31
6	9.92	10.32	9.73	10.43
7	9.96	10.41	9.69	10.45
7	10.08	10.54	9.71	10.39
8	9.92	10.29	9.72	10.46
8	9.99	10.73	9.57	10.54
9	9.96	10.65	9.53	10.35
9	10.04	10.65	9.65	10.32
10	10.03	10.41	9.48	10.29
10	9.86	10.67	9.81	10.51

Table S2 The effective counting rates (100 s) of each element in samples with concentration of 10  $\mu\text{g g}^{-1}$  at different moisture contents

Moisture content (%)	Counting rates (100 s)			
	As	Hg	Tl	Pb
100	33746.97	21439.55	22733.17	23316.83
	33464.87	20540.10	21965.90	23558.57
	34723.70	21352.97	23894.87	23479.10
90	34377.10	20891.95	23090.93	23784.87
	33359.60	20482.70	22228.13	23951.30
	35677.85	21900.13	24159.47	22459.90
80	33475.93	20928.73	22256.50	22770.90
	33417.83	20713.45	22033.33	23405.45
	34323.30	20531.75	22497.90	22678.60
70	33539.90	21519.57	22053.10	23378.80
	33768.57	20947.70	22010.00	23135.00
	34301.80	20269.95	23931.35	23631.90
60	34007.10	21118.75	22638.87	22176.03
	34873.25	21117.05	22592.95	23927.60
	34293.20	20772.50	22509.20	23370.40
50	33459.10	20987.20	21720.70	22656.50
	35463.20	21608.70	23713.77	23714.80
	34536.35	21537.30	23103.90	22259.20

Table S3 The effective counting rates (100 s) of each element at different sample weight

Concentration ( $\mu\text{g g}^{-1}$ )	Sample weight (g)	Counting rates (100 s)			
		AS	Hg	Tl	Pb
0.5	0.1	1425.62	970.57	1040.98	1086.02
	0.2	1700.95	1093.20	1101.08	1163.88
	0.3	1832.93	1150.09	1219.45	1201.44
	0.4	1840.77	1145.55	1226.76	1194.52
	0.5	1891.90	1147.38	1244.18	1180.80
	0.6	1852.04	1130.90	1213.24	1194.92
10	0.1	22981.37	13775.77	15547.05	14688.50
	0.2	31892.70	18481.23	21045.20	20638.77
	0.3	35328.27	20348.63	22838.77	23102.53
	0.4	35366.20	20767.60	23298.57	23242.67
	0.5	35733.00	20598.45	23283.57	23477.00
	0.6	35366.20	20826.00	23681.30	23559.40
100	0.1	241274.00	137124.00	154733.67	143984.67
	0.2	323084.00	187570.67	223681.33	182286.67
	0.3	335683.67	217531.50	230509.50	244614.67
	0.4	328818.33	217927.00	226820.00	245336.00
	0.5	332519.00	215054.00	231326.00	249154.67
	0.6	332515.00	220078.00	230177.50	250076.00

Table S4 The measured values of each element at different measurement times at a concentration of 0.5  $\mu\text{g g}^{-1}$

Element	Serial number	Measured values ( $\mu\text{g g}^{-1}$ )			
		30 (s)	60 (s)	100 (s)	200 (s)
As	1	0.59	0.52	0.58	0.55
	2	0.48	0.57	0.56	0.55
	3	0.53	0.54	0.55	0.53
	4	0.53	0.52	0.53	0.56
	5	0.52	0.55	0.56	0.55
	6	0.51	0.53	0.53	0.54
	7	0.62	0.55	0.53	0.56
Hg	1	0.47	0.46	0.49	0.51
	2	0.47	0.48	0.50	0.53
	3	0.49	0.50	0.51	0.51
	4	0.50	0.49	0.50	0.53
	5	0.50	0.47	0.49	0.49
	6	0.47	0.49	0.53	0.51
	7	0.44	0.52	0.51	0.50
Tl	1	0.45	0.44	0.47	0.47
	2	0.53	0.46	0.50	0.48
	3	0.47	0.53	0.48	0.49
	4	0.57	0.50	0.45	0.46
	5	0.58	0.46	0.44	0.47
	6	0.46	0.51	0.50	0.47
	7	0.44	0.50	0.49	0.47
Pb	1	0.55	0.56	0.56	0.56
	2	0.59	0.55	0.59	0.59
	3	0.57	0.61	0.58	0.63
	4	0.59	0.61	0.62	0.59
	5	0.62	0.53	0.55	0.54
	6	0.57	0.62	0.62	0.59
	7	0.46	0.59	0.58	0.57

Table S5 The measured values of each element at different measurement times at a concentration of 10  $\mu\text{g g}^{-1}$

Element	Serial number	Measured values ( $\mu\text{g g}^{-1}$ )			
		30 (s)	60 (s)	100 (s)	200 (s)
As	1	10.23	10.52	10.45	10.32
	2	10.49	10.62	10.35	10.40
	3	10.34	10.50	10.35	10.34
	4	10.23	10.42	10.35	10.34
	5	10.37	10.53	10.38	10.33
	6	10.38	10.61	10.40	10.43
	7	10.28	10.40	10.41	10.36
Hg	1	10.38	10.16	10.37	9.97
	2	10.80	10.09	10.27	10.05
	3	10.49	10.05	10.24	9.99
	4	10.52	9.86	10.22	10.05
	5	10.48	10.02	10.20	9.93
	6	10.85	10.00	10.35	10.09
	7	10.38	10.01	10.31	9.89
Tl	1	10.32	10.33	10.42	10.26
	2	10.28	10.13	10.36	10.34
	3	10.47	10.43	10.46	10.17
	4	10.33	10.33	10.50	10.38
	5	10.31	10.34	10.37	10.24
	6	10.55	10.43	10.39	10.37
	7	10.58	10.49	10.38	10.31
Pb	1	10.17	10.36	10.53	9.88
	2	10.54	10.17	10.52	9.81
	3	10.59	10.29	10.64	9.83
	4	10.33	10.21	10.79	9.77
	5	10.47	10.32	10.45	9.83
	6	10.55	10.40	10.47	9.75
	7	10.45	10.12	10.66	9.62



Table S6 The measured values of each element at different measurement times at a concentration of 100  $\mu\text{g g}^{-1}$

Element	Serial number	Measured values ( $\mu\text{g g}^{-1}$ )			
		30 (s)	60 (s)	100 (s)	200 (s)
As	1	100.86	101.47	100.86	100.86
	2	101.21	101.81	100.86	100.60
	3	101.55	101.21	100.09	100.52
	4	101.29	101.55	100.86	100.60
	5	99.83	101.81	101.03	100.34
	6	100.26	101.38	100.78	100.69
	7	100.60	101.29	101.03	100.78
Hg	1	102.54	103.69	107.00	109.08
	2	102.62	103.92	106.77	109.46
	3	102.31	104.23	107.08	108.85
	4	102.54	104.31	107.00	109.69
	5	102.92	104.62	106.54	109.54
	6	102.15	104.31	106.77	109.92
	7	102.77	104.00	107.38	109.15
Tl	1	109.80	111.10	109.50	108.20
	2	109.60	110.10	109.30	108.00
	3	110.20	111.10	110.20	108.40
	4	110.50	111.00	109.90	108.20
	5	109.70	110.70	109.30	107.90
	6	109.90	110.80	109.20	108.50
	7	110.50	110.80	109.20	108.70
Pb	1	104.08	106.23	105.69	101.00
	2	104.85	106.00	105.62	100.93
	3	104.38	106.69	106.00	101.00
	4	104.15	106.00	105.54	101.00
	5	105.69	106.15	105.54	101.20
	6	104.77	106.23	105.46	100.87
	7	103.92	106.15	105.23	101.07

Table S7 The measured values of each element under different substrates at a concentration of 0.5  $\mu\text{g g}^{-1}$

Substrate	Serial number	Measured values ( $\mu\text{g g}^{-1}$ )			
		As	Hg	Tl	Pb
Pig liver	1	0.44	0.47	0.46	0.48
	2	0.47	0.49	0.46	0.47
	3	0.45	0.45	0.54	0.49
Lamb liver	1	0.49	0.47	0.46	0.49
	2	0.48	0.45	0.50	0.49
	3	0.46	0.47	0.50	0.49
Pig kidney	1	0.43	0.51	0.45	0.56
	2	0.45	0.44	0.51	0.51
	3	0.49	0.52	0.53	0.54
Pig heart	1	0.41	0.46	0.48	0.43
	2	0.55	0.46	0.46	0.49
	3	0.43	0.46	0.50	0.52
Pig lung	1	0.47	0.48	0.50	0.49
	2	0.45	0.49	0.51	0.52
	3	0.57	0.45	0.53	0.48

Table S8 The measured values of each element under different substrates at a concentration of 10 µg g<sup>-1</sup>

Substrate	Serial number	Measured values (µg g <sup>-1</sup> )			
		As	Hg	Tl	Pb
Pig liver	1	10.35	10.01	10.41	10.89
	2	10.26	10.29	10.39	10.40
	3	10.34	8.95	10.43	10.84
Lamb liver	1	10.46	9.66	10.41	10.54
	2	10.10	9.74	10.61	10.56
	3	10.36	9.43	10.65	10.73
Pig kidney	1	10.65	11.13	10.41	11.01
	2	10.52	10.25	10.64	10.50
	3	10.69	11.09	10.72	11.29
Pig heart	1	8.87	9.78	10.31	10.35
	2	10.74	10.16	10.41	11.43
	3	10.71	9.79	10.28	11.13
Pig lung	1	10.45	10.35	10.36	10.16
	2	10.61	9.37	10.57	10.66
	3	10.04	10.00	10.39	10.54

Table S9 The measured values of each element under different substrates at a concentration of 100 µg g<sup>-1</sup>

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Substrate	Serial number	Measured values (µg g <sup>-1</sup> )			
		As	Hg	Tl	Pb
Pig liver	1	104.60	102.30	104.00	102.50
	2	106.20	102.90	103.80	105.10
	3	104.90	104.30	104.10	105.70
Lamb liver	1	102.20	99.88	98.33	93.65
	2	103.50	104.20	100.80	112.30
	3	96.63	99.39	99.05	115.60
Pig kidney	1	101.50	103.20	102.70	105.30
	2	100.30	103.40	103.00	112.92
	3	101.30	104.60	103.00	118.19
Pig heart	1	109.50	108.10	96.92	96.07
	2	98.64	90.04	105.10	98.71
	3	119.96	116.82	103.58	102.86
Pig lung	1	103.30	103.62	100.40	95.10
	2	101.20	91.26	103.50	105.20
	3	99.24	116.30	103.90	103.90