

Supplementary material

An optimized preconcentration method using magnetic solid-phase dispersive microextraction with GO/ γ -Fe₂O₃ nanoparticles for the determination of Se in fish samples by FIA-HG-AAS

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Table S1 – Experimental design for the sample preparation of fish sample using MAD and Selenium and Carbon determination using ICP-OES (the codified values are shown as the number in parentheses).

Experiment	Factors		Responses	
	HNO ₃ (mL)	Mass of sample (g)	Se µg L ⁻¹	C µg L ⁻¹
1	1.0 (-1)	0.2 (-1)	123.5	438.9
2	3.5 (1)	0.2 (-1)	112	358.4
3	1.0 (-1)	0.7 (1)	310.9	1491.8
4	3.5 (1)	0.7 (1)	239.3	992
5	2.3 (0)	0.45 (0)	192.5	775.6
6	2.3 (0)	0.45 (0)	191.6	665.7
7	2.3 (0)	0.45 (0)	179.1	688
8	0.5 (-1.414)	0.45 (0)	253	1234.1
9	4.0 (1.414)	0.45 (0)	169.5	667.9
10	2.3 (0)	0.1 (-1.414)	96.8	258
11	2.3 (0)	0.8 (1.414)	360.1	1526.2

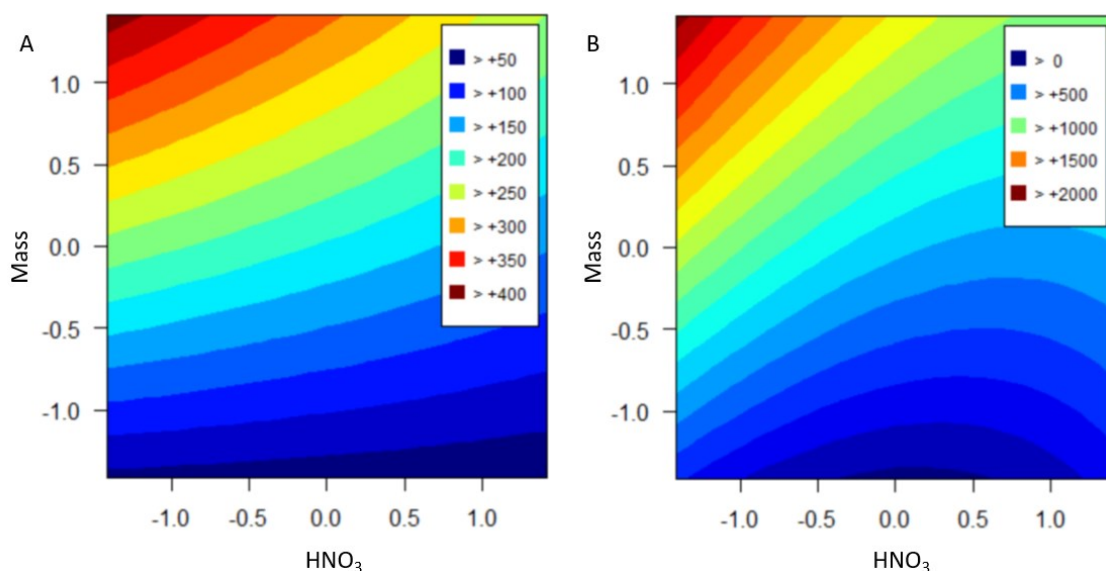


Figure S1. Contour plot of the model for the sample preparation in a MAD and (A) Se and (B) C determination using ICP-OES.

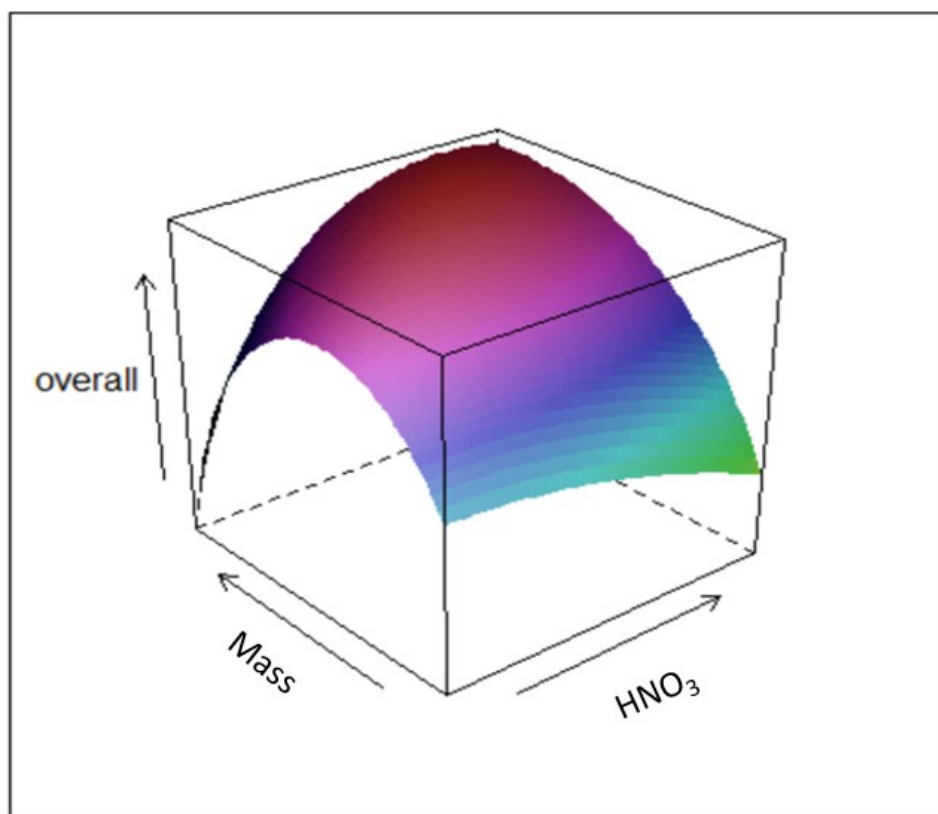


Figure S2. The surface response for the overall desirability for the sample preparation via microwave-assisted digestion.

Table S2. Experimental design for optimization of the parameters in adsorption process without foreign ions (the codified values were shown as the number in parentheses).

Experiment	Factors			Response
	Agitation Time (min)	pH	Mass of MNPs (mg)	Se ($\mu\text{g L}^{-1}$)
1	20 (-1)	5 (-1)	6.7 (-1)	14.7
2	50 (1)	5 (-1)	6.7 (-1)	13.3
3	20 (-1)	7 (1)	6.7 (-1)	36.5
4	50 (1)	7 (1)	6.7 (-1)	37.5
5	20 (-1)	5 (-1)	11.7 (1)	7.5
6	50 (1)	5 (-1)	11.7 (1)	7
7	20 (-1)	7 (1)	11.7 (1)	27.8
8	50 (1)	7 (1)	11.7 (1)	29.4
9	35 (0)	6 (0)	9.2 (0)	23.7
10	35 (0)	6 (0)	9.2 (0)	22.8
11	35 (0)	6 (0)	9.2 (0)	24.7
12	35 (0)	6 (0)	9.2 (0)	23.3
14	10 (-1.682)	6 (0)	9.2 (0)	18.3
15	60 (1.682)	6 (0)	9.2 (0)	18.7

16	35 (0)	4 (-1.682)	9.2 (0)	26.8
17	35 (0)	8 (1.682)	9.2 (0)	25.3
18	35 (0)	6 (0)	5.0 (-1.682)	18.9
19	35 (0)	6 (0)	13.3 (1.682)	11.8

Table S3. Experimental design for adsorption conditions with a solution containing foreign ions (Ca, K, Mg and P) and determination of Se by HG-AAS (the codified values were shown as the number in parentheses).

Experiment	Factors			Response
	Agitation Time (min)	pH	Mass of MNPs (mg)	Se ($\mu\text{g L}^{-1}$)
1	10 (-1)	3.5 (-1)	25 (-1)	20.19
2	35 (1)	3.5 (-1)	25 (-1)	11.55
3	10 (-1)	8.5 (1)	25 (-1)	46.36
4	35 (1)	8.5 (1)	25 (-1)	40.38
5	10 (-1)	3.5 (-1)	70 (1)	12.73
6	35 (1)	3.5 (-1)	70 (1)	8.86
7	10 (-1)	8.5 (1)	70 (1)	35
8	35 (1)	8.5 (1)	70 (1)	36.01
9	23 (0)	6 (0)	48 (0)	24.72
10	23 (0)	6 (0)	48 (0)	24.49
11	23 (0)	6 (0)	48 (0)	29.93
12	1 (-1.682)	6 (0)	48 (0)	32.45
13	44 (1.682)	6 (0)	48 (0)	29.69
14	23 (0)	2 (-1.682)	48 (0)	2.91
15	23 (0)	10 (1.682)	48 (0)	48.14
16	23 (0)	6 (0)	10 (-1.682)	35.41
17	23 (0)	6 (0)	85 (1.682)	26.91

Table S4. Experimental design for hydride generation conditions with a solution $40 \mu\text{g L}^{-1}$ of Se, in EDTA/NaOH (1 mol L^{-1}) (the codified values are shown as the number in parentheses).

Experiment	Factors			Response
	[HCl] (v/v) %	[NaBH ₄] (w/v) %	Argon Flow (mL min ⁻¹)	Analytical signal
1	8 (-1)	0.30 (-1)	150 (-1)	7.93
2	25 (1)	0.30 (-1)	150 (-1)	9.49
3	8 (-1)	0.80 (1)	150 (-1)	5.34
4	25 (1)	0.80 (1)	150 (-1)	5.53

5	8 (-1)	0.30 (-1)	350 (1)	8.43
6	25 (1)	0.30 (-1)	350 (1)	7.72
7	8 (-1)	0.80 (1)	350 (1)	6.45
8	25 (1)	0.80 (1)	350 (1)	6.95
9	16.5 (0)	0.55 (0)	250 (0)	8.57
10	16.5 (0)	0.55 (0)	250 (0)	8.83
11	16.5 (0)	0.55 (0)	250 (0)	9.41
12	16.5 (0)	0.55 (0)	250 (0)	9.65
13	16.5 (0)	0.55 (0)	250 (0)	8.37
14	16.5 (0)	0.55 (0)	250 (0)	8.12
15	2 (-1.682)	0.55 (0)	250 (0)	8.10
16	31 (1.682)	0.55 (0)	250 (0)	6.11
17	16.5 (0)	0.13 (-1.682)	250 (0)	7.58
18	16.5 (0)	0.97 (1.682)	250 (0)	7.06
19	16.5 (0)	0.55 (0)	82 (-1.682)	0.49
20	16.5 (0)	0.55 (0)	418 (1.682)	7.64

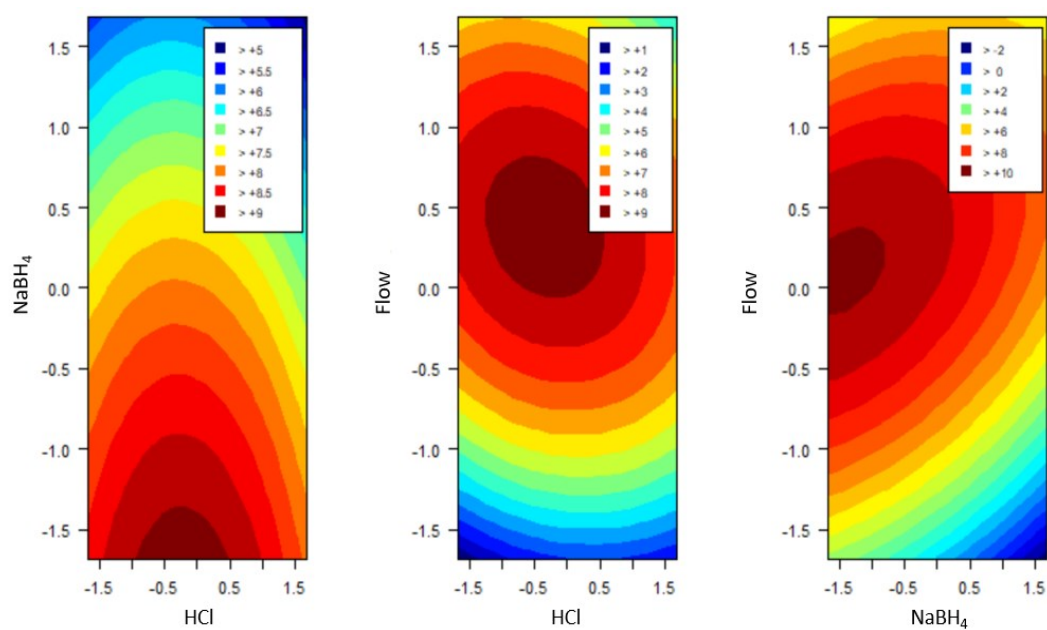


Figure S3. Contour plot with all factors investigated for Se determination via FIA-HG-AAS.