Use of Fe3O4 magnetic nanoparticles coated with polythiophene for simultaneous preconcentrations of Cu (II), Co (II), Cd (II), Ni (II) and Zn (II) ions prior to their determination by MIS-FAAS

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(a)

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(b)

Figure S1. ATR-IR spectra of (a) bare Fe3O4 and (b) synthesised Fe3O4-PTh magnetic nanoparticles.

Figure S2. Effect of adsorption time on the recoveries of the metal ions (n=3)

Figure S3. Effect of desorption time on the recoveries of the metal ions (n:3)

Table S1. Statistical evaluation for precision of the developed method

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | bFratio | cP | | % Precisionsa  (N=3, days:4) | |
| Intraday | Interday |
| Tap Water |  |  |  | |  |
| Cu(II) | 1.91 | 0.21 | 1.4 | | 1.9 |
| Co(II) | 1.89 | 0.21 | 1.6 | | 2.0 |
| Cd(II) | 1.71 | 0.24 | 1.3 | | 1.5 |
| Ni(II) | 2.52 | 0.13 | 1.8 | | 2.4 |
| Zn(II) | 0.88 | 0.49 | 1.3 | | 1.4 |
|  |  |  |  | |  |
| Mineral Water |  |  |  | |  |
| Cu(II) | 0.99 | 0.45 | 1.2 | | 1.8 |
| Co(II) | 1.74 | 0.24 | 1.2 | | 1.2 |
| Cd(II) | 2.13 | 0.17 | 1.3 | | 1.3 |
| Ni(II) | 3.27 | 0.08 | 1.2 | | 1.9 |
| Zn(II) | 1.51 | 0.28 | 1.0 | | 1.2 |
|  |  |  |  | |  |
| Urban Wastewater  Treatment Plants Outlet | | |  | |  |
| Cu(II) | 1.28 | 0.35 | 1.6 | | 1.8 |
| Co(II) | 1.27 | 0.35 | 1.6 | | 1.6 |
| Cd(II) | 0.45 | 0.73 | 1.3 | | 1.4 |
| Ni(II) | 3.41 | 0.07 | 1.3 | | 1.9 |
| Zn(II) | 0.32 | 0.81 | 1.3 | | 1.3 |
|  |  |  |  | |  |
| Hot Spring Water (Karahayıt) |  |  |  | |  |
| Cu(II) | 0.24 | 0.87 | 2.3 | | 2.4 |
| Co(II) | 0.24 | 0.87 | 1.4 | | 1.5 |
| Cd(II) | 0.53 | 0.67 | 1.3 | | 1.5 |
| Ni(II) | 0.97 | 0.45 | 1.3 | | 1.4 |
| Zn(II) | 1.19 | 0.37 | 1.0 | | 1.1 |
|  |  |  |  | |  |
| Thermal Water (Pamukkale) |  |  |  | |  |
| Cu(II) | 0.07 | 0.98 | 2.1 | | 2.4 |
| Co(II) | 0.23 | 0.87 | 1.5 | | 1.8 |
| Cd(II) | 0.12 | 0.94 | 1.4 | | 1.6 |
| Ni(II) | 0.13 | 0.94 | 1.7 | | 2.0 |
| Zn(II) | 0.82 | 0.52 | 1.3 | | 1.5 |
|  |  |  |  | |  |
| Black Radish Root |  |  |  | |  |
| Cu(II) | 3.32 | 0.08 | 2.4 | | 3.4 |
| Co(II) | 0.12 | 0.94 | 5.9 | | 6.2 |
| Cd(II) | 0.51 | 0.68 | 4.4 | | 5.1 |
| Ni(II) | 0.86 | 0.50 | 2.7 | | 2.9 |
| Zn(II) | 0.08 | 0.97 | 6.1 | | 6.3 |
|  |  |  |  | |  |
| Parsley |  |  |  | |  |
| Cu(II) | 0.13 | 0.94 | 4.1 | | 5.4 |
| Co(II) | 0.51 | 0.68 | 4.9 | | 5.2 |
| Cd(II) | 0.56 | 0.65 | 6.1 | | 7.4 |
| Ni(II) | 0.85 | 0.51 | 3.3 | | 5.0 |
| Zn(II) | 1.37 | 0.32 | 2.6 | | 3.6 |
|  |  |  |  | |  |
| Quince |  |  |  | |  |
| Cu(II) | 0.12 | 0.95 | 4.9 | | 6.0 |
| Co(II) | 1.30 | 0.34 | 7.2 | | 8.1 |
| Cd(II) | 0.07 | 0.98 | 7.7 | | 9.2 |
| Ni(II) | 1.12 | 0.40 | 3.0 | | 4.4 |
| Zn(II) | 2.02 | 0.19 | 2.9 | | 4.6 |

a, Precision as relative standard deviation, RSD % was calculated by one-way analysis of variance (ANOVA),

b Fcritical=4,062 from table, calculated Fratio, c Calculated P values

Table 2S. Uncertainty of measurement for analysis real samples with the suggested procedure

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Analyte ions | Uncertainity of Measurement, %, (n=3) | | | | | | | |
| Tap Water | Mineral Water | Urban Wastewater  Treatment Plants Outlet | Hot Spring Water (Karahayıt) | Thermal Water (Pamukkale) | Black Radish | Parsley | Quince |
| Cu(II) | 3.4 | 2.2 | 3.6 | 4.9 | 2.9 | 4.5 | 4.5 | 5.1 |
| Co(II) | 6.1 | 6.3 | 6.2 | 6.1 | 5.9 | 6.1 | 6.1 | 6.1 |
| Cd(II) | 2.3 | 2.9 | 2.1 | 2.8 | 2.3 | 5.8 | 6.1 | 5.0 |
| Ni(II) | 2.3 | 3.3 | 3.4 | 2.7 | 3.4 | 4.5 | 5.2 | 5.9 |
| Zn(II) | 1.9 | 1.6 | 2.1 | 1.8 | 1.8 | 2.1 | 2.5 | 2.2 |