

Multicommuted flow injection system with HGAAS for the determination of selenium in foodstuffs and environmental samples



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Introduction

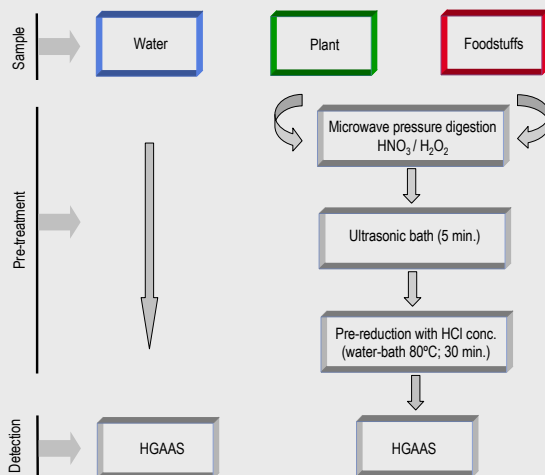
Selenium and its compounds can be found in the environment and in foodstuffs. It is nutritionally important mainly due to its antioxidant properties but it can be toxic for human health, depending on its concentration level.

A flow system based on the multicommuted flow injection analysis (MCFIA) was developed for the determination of total selenium by hydride generation atomic absorption spectrophotometry (HGAAS).

The system uses three independently controlled solenoid valves for the introduction of reagents and samples similar to the one reported for the determination of mercury [1]. The developed system was applied to the analysis of foodstuffs and environmental samples.

Sample Treatment

The sample treatment procedures were based on [2, 3] and optimized for the different sample matrices.



Sample Analysis

Results for certified reference materials found for the HGAAS selenium determination using the developed multicommuted flow system

Reference Material	Certified Value ^a	MCFIA ^b	Number of replicates
Sea lettuce (CRM 279)	593 ± 32 µg kg ⁻¹	530 ± 16 µg kg ⁻¹	5
Spinach leaves (SRM 1570a)	117 ± 9 µg kg ⁻¹	107 ± 4 µg kg ⁻¹	9
Surface water (SPS-SW2)	10.0 ± 0.05 µg l ⁻¹	10.2 ± 0.3 µg l ⁻¹	3
Tr-218 (Inter 2000)	2.5 ± 2 µg l ^{-1c}	2.7 ± 0.1 µg l ⁻¹	15
Dogfish (DORM-2)	1.40 ± 0.09 µg kg ⁻¹	1.15 ± 0.03 µg kg ⁻¹	5
Pig Kidney (CRM 186)	10.3 ± 0.5 µg kg ⁻¹	10.5 ± 0.4 µg kg ⁻¹	5
Bovine liver (CRM 185)	446 ± 13 µg kg ⁻¹	372 ± 39 µg kg ⁻¹	5

^a Certified value ± uncertainty.

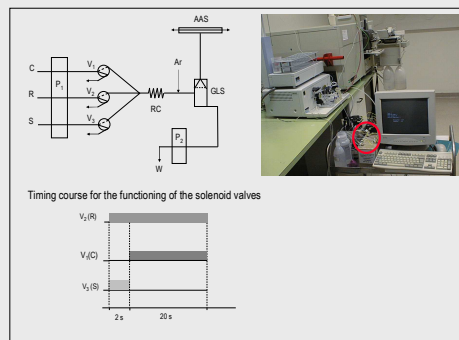
^b Average value ± standard deviation of the results.

^c Proficiency testing mean ± half with of the acceptance interval.

Acknowledgements

I.V. Tóth thanks FCT and FSE for the grant SFRH/BPD/563/2001.

Manifold



Manifold of the MCFIA system for the determination of selenium: C, carrier HCl 10% (v/v); R, reducing reagent NaBH₄ 0.2% (m/v) in NaOH 0.05% (m/v); S, sample or working standard solutions; P₁ e P₂, peristaltic pumps; V₁ – V₃, three way solenoid valves; RC, reaction coil 100 cm; Ar, argon carrier gas 100 ml min⁻¹; GLS, gas-liquid separator; AAS, atomic absorption spectrometer quartz cell; W, waste.

Figures of Merit

Analytical parameters found for the HGAAS selenium determination using the developed multicommuted flow system

	MCFIA
LOD (3σ)/µg l ⁻¹ (n=10)	0.8
LOQ (10σ)/µg l ⁻¹ (n=10)	1.5
RSD, %	2.9 (2.5 µg l ⁻¹) 3.0 (10 µg l ⁻¹)
Dynamic working range/µg l ⁻¹	1.5 - 10
Regression equation ^a y = mx + b	
m, Slope/µg l ⁻¹	0.0236 ± 0.0030
b, Intercept	0.0059 ± 0.0048
(n=5)	
Correlation coefficient	0.9992
Determination rate/h ⁻¹	116
Sample consumption/µl	210
Reagent consumption ^b	
HCl conc./ml	0.4
NaBH ₄ /mg	4.4
NaOH/mg	1.1
Waste ^b /ml	6.4

LOD, limit of detection; LOQ, limit of quantification; RSD, Relative standard deviation.

^a Mean and standard deviation of the calibration curve parameters of 5 different working days, where y is the analytical signal peak area and x the concentration of selenium in µg l⁻¹.

^b Values per assay.

The developed multicommuted flow system has proved to be rapid and accurate for the determination of selenium in foodstuffs and environmental samples.

References

- [1] M. F. Silva, I. V. Tóth, A. O. S. S. Rangel, Anal. Sci., 22 (2006) 861.
- [2] Manuel Suisse des denrées alimentaires, Ed. 2005.
- [3] Standard methods for the examination of water and wastewater, 19th Ed. 1995.