Slovak Society of Chemical Engineering
Institute of Chemical and Environmental Engineering
Slovak University of Technology in Bratislava

PROCEEDINGS

51st International Conference of the Slovak Society of Chemical Engineering SSCHE 2025

Hotel DRUŽBA
Jasná, Demänovská Dolina, Slovakia
May 27 - 30, 2025

Editors: Assoc. Prof. Mário Mihaľ

ISBN: 978-80-8208-158-2, EAN: 9788082081582

Published by the Faculty of Chemical and Food Technology Slovak Technical University in Bratislava in Slovak Chemistry Library for the Institute of Chemical and Environmental Engineering; Radlinského 9, 812 37 Bratislava, 2024

Covaci, E., Mot, A., Dudu, A., Frentiu, T.: Green and white method for the determination of selected essential and toxic elements in vegetable and meat-based samples by small-sized electrothermal vaporization capacitively coupled microplasma optical emission spectrometry and combustion-assisted digestion, Editors: Mihaľ, M., In *51st International Conference of the Slovak Society of Chemical Engineering SSCHE 2025*, Jasná, Demänovská Dolina, Slovakia, 2025.

Green and white method for the determination of selected essential and toxic elements in vegetable and meat-based samples by small-sized electrothermal vaporization capacitively coupled microplasma optical emission spectrometry and combustion-assisted digestion

[1,2]Eniko Covaci*, [1]Augustin-Catalin Mot, [1]Adrian-Ioan Dudu,[1,2] Tiberiu Frentiu

[1] Babes-Bolyai University, Faculty of Chemistry and Chemical Engineering, 11 Arany Janos, 400028, Cluj-Napoca, Romania
[2] Babes-Bolyai University, Research Centre for Advanced Analysis, Instrumentation and Chemometrics, Arany Janos 11, 400028 Cluj-Napoca, Romania

Corresponding author: e-mail: eniko.covaci@ubbcluj.ro

Key words: microplasma source, essential element, toxic element, combustion-assisted digestion

The determination of essential and toxic elements, such as Se, Zn, Cu, Cd, Hg and As, using green sample preparation techniques coupled with miniaturized instrumentation, is a critical research focus in the field of analytical methods development. Thus, the aim of this study was the development of a green and white method based on oxygen flask combustion of the sample, and detection by optical emission spectrometry using small-sized electrothermal vaporization capacitively coupled microplasma optical emission spectrometry. The microsample (10 µL) was vaporized from a small-sized Rh-coiled filament, while the low power (15 W) and low Ar consumption (150 mL min^{-1}) microplasma was used as excitation source and a low-resolution microspectrometer was used for recording the multielemental spectrum. The combustion method, as a greener alternative to wet acid digestion, involved weighing 50–100 mg sample, wrapping it in a small ashless filter paper, and placing it in a platinum basket. The sample was then combusted in an oxygen-filled Erlenmeyer flask, and the combustion gas was absorbed in a volume of 10 mL 0.1 mol L^{-1} HCl solution. In order to verify the effectiveness of the combustion-based digestion, the samples were microwave-assisted digested in concentrated HNO_3 - H_2O_2 mixture. The accuracy (recovery and precision) of the method was evaluated by analyzing several certified reference materials (CRMs), using both external calibration and standard addition method. The recovery degrees were in the range of 90–112% and 98–113% for external calibration and standard addition method, respectively, while the precision, expressed as relative standard deviation, was in the range of 4.8–14.5% and 4.6–13.3%. The results were similar to those obtained by microwave classical digestion, with recovery and precision in the range of 91–111%, and 6.7–13.7%, respectively.

Acknowledgements. This work was supported by a grant of the Romanian Ministry of Research, Innovation and Digitization, CNCS/CCCDI-UEFISCDI, contract nr. 15PED/2025, project number PN-IV-P7-7.1-PED-2024-0091, within PNCDI IV.