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Development and validation of a quantification method for the simultaneous measurement of radionuclides, phosphorous and sulfur using ICP-MS/MS

MAJD SHMEIT[1], HÉLÈNE ISNARD[1], SANDRA BARHOUM[1,2], MARINE BOUDIAS[1], NIKITA IVANOV[1] AND CAROLE BRESSON[1]

[1]Université Paris-Saclay, CEA, Service de Physico-Chimie, 91191 Gif-Sur-Yvette, France

[2]Institut de Chimie et des Matériaux Paris-Est (ICMPE), UMR 7182 CNRS-UPEC, Thiais, France.

In case of accidental contamination by radionuclides (RNs), the characterization of their interactions with *in vivo* targeted biomolecules and chelating molecules is of major concern to better understand the toxicity mechanisms and develop selective decorporating agents. In this context, recent studies aimed at investigating interactions of Pu and Am with proteins by developing capillary-based analytical systems grafted by functionalized monolithic polymers (Barhoum et al., 2024). The monoliths are devoted to immobilize the RNs, and circulating proteins will interact and elute differentially according to their affinity for the RNs. The capillary-based analytical systems are then coupled to inductively coupled plasma tandem mass spectrometry (ICP-MS/MS) to characterize the eluent through its multielemental composition. The ICP-MS/MS is the technique of reference for the simultaneous quantification of both protein constituent elements (P and S) and RNs with high sensitivity, using generic universal standards, and overcoming the need of synthesizing protein-specific standards.

The objective of this study is to investigate the potential of ICP-MS/MS to quantify within a single set of optimal parameters RNs of major interest in the nuclear sector (Co, Sr, Zr, Ag, Cs, Sm, Th, U) and P, S-containing biomolecules. Preliminary quantification and isotope-ratio assessments will be presented from measurements by a latest generation ICP-MS/MS (Agilent 8900), and using natural mono-elemental solutions. The quantification method will be initially developed using O_2 reaction gas to quantify simultaneously the elements at their interference-free masses (M^+, MO^+, and/or MO_2^+). Instrumental parameters will be defined in order to determine the optimal signal/noise ratio for each element (ex., cell gas %, kinetic energy discrimination), and then a compromise will be determined to develop a method for the simultaneous measurement of all elements of interest. Moreover, in order to achieve the most accurate quantification, different internal standards (Sc, Ga, Ge, Y, In, Tm, Lu, Bi) will be tested. The development of such simultaneous multielemental quantification method is a key step for the following coupling of monolithic capillary to ICP-MS/MS, intended for a time-resolved and multiplex analysis of RNs interactions with biomolecules.

Barhoum et al., 2024. Microchimica Acta, 191(4), p.191.