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Spectroscopic investigation of the speciation of uranium(VI) in the biofluids of the human digestive system

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In case radionuclides (RN) enter the food chain and are incorporated by humans, they pose a possible health risk due to their radio- and chemotoxicity. Therefore, it is necessary to know the biokinetic processes as well as the speciation of the RN after ingestion in order to develop and improve specific methods for their decorporation. When RN are ingested orally, they first come into contact and interact with the biofluids of the digestive tract. However, for most actinides, little is known to date about their speciation and biochemical behavior in the gastrointestinal tract.
Therefore, the aim of this study was to investigate the interactions of hexavalent uranium in the gastrointestinal compartments and respective biofluids in the stomach (saliva and gastric juice) and small intestine (pancreatic juice and bile fluid). The combination of these two segments was also considered. Biofluids and digestive steps were artificially simulated based on human physiology. The chemical speciation of uranium was investigated using cryogenic time-resolved laser-induced fluorescence spectroscopy (cryo-TRLFS) at 153 K. The results were compared with thermodynamic modeling.
The TRLFS experiments show that uranium is predominantly complexed with inorganic ligands, mainly carbonate and to a smaller extent phosphate, as confirmed by thermodynamic modeling. For the organic ligands, only some proteins, e.g. prancreatin, are involved in the speciation to a small extent. Based on this knowledge, specific decorporation agents can be developed and their influence on uranium speciation can be observed using cryo-TRLFS.

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Primary author: BUTSCHER, Daniel (Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Institute of Resource Ecology)

Co-authors: Dr BARKLEIT, Astrid (Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Institute of Resource Ecology); Prof. STUMPF, Thorsten (Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Institute of Resource Ecology)

Presenter: Dr BARKLEIT, Astrid (Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Institute of Resource Ecology)

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