MERCURY–SELENIUM INTERACTIONS IN BIOTA: UNRAVELING MECHANISMS THROUGH ADVANCED ANALYTICAL STRATEGIES IN AMAZONIAN FISH

Marianna Alves Cancian[1], Beatriz Gomez- Gomez[2], Antonio Humberto Hamad Minervino[3], Fabio Edir Amaral Albuquerque [3], Maité Bueno[1], David Amouroux[1], Zoyne Pedrero Zayas[1].

[1] Université de Pau et des Pays de l'Adour, CNRS, IPREM, Institut des Sciences Analytiques et de Physico- chimie pour l'Environnement et les Matériaux, Pau, France.
[2] Analytical Chemistry Department, Faculty of Chemical Sciences, Complutense University of Madrid, Madrid, 2S040
[3] Laboratoy of Animal Health (LARSANA), Federal University of Western Pará (UFOPA), Street Vera Paz, s/n, Salé, CEP 68040-255 Santarém, PA, Brazil

INTRODUCTION: Mercury (Hg) ranks among the World Health Organization's top ten chemicals of public health concern, yet its metabolic pathways and ultimate fate in living organisms remain elusive. Selenium (Se), an essential trace element, is believed to mitigate Hg toxicity, although the precise mechanisms remain unclear. Fish consumption is the principal dietary source of Hg for humans, a concern that is especially critical for riverside communities in the Amazon, where people rely heavily on fish for sustenance and where Hg pollution has long been a pressing issue. Most research on Hg–Se interactions focuses on marine species, with freshwater studies limited mainly to total element measurements, even though toxicity and environmental fate are strongly influenced by their chemical forms. Notably, key Se-compounds such as selenoneine, a potent antioxidant Se-amino acid and tiemannite (HgSe)—recognized as potential end-products of methylmercury detoxification—have not yet been characterized in freshwater species. Furthermore, divergent bioaccumulation patterns between marine and freshwater ecosystems suggest the presence of distinct Se species.

OBJECTIVE: This study aims to advance our understanding of the fate of mercury in fish, with an emphasis on its potential detoxification by selenium. Particular attention is given to the mechanisms at play in freshwater fish from the Brazilian Amazon.

MATERIALS AND METHODS:

Representative freshwater fish (with different dietary habits) from the Brazilian Amazon were investigated. Hg and Se nanoparticles were enzymatically isolated from different organs as muscle and live, then analyzed by single-particle inductively coupled plasma mass spectrometry (spICP-MS).

RESULTS AND CONCLUSION:

This study documents, for the first time, the presence of Hg and Se nanoparticles in freshwater fish, with significant implications for understanding Hg's fate in these organisms. The findings have global relevance, extending to the biogeochemical cycle of Hg and broader environmental toxicology. The potential of advanced analytical strategies—such as biomolecular speciation and isotopic tracing—will also be discussed, offering new perspectives on Hg–Se interactions in biota.

Keywords: Mercury, selenium, fish, Amazon, speciation