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ON-SITE APPROACH FOR MERCURY DETERMINATION AND SPECIATION

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Fish, mussels and crustaceans have played a key role in human history by providing essential nutrients for the livelihoods of people living in coastal areas. Contamination of water by inorganic mercury (Hg_{IN}) and methylmercury (CH_3Hg) is a serious issue for the underwater ecosystem. Especially CH_3Hg , which is the most toxic organic compound of Hg, is subjected to bioaccumulation and biomagnification in fish because of its lipophilicity. Such an event is magnified along the food chain, eventually reaching mankind. Mercury is extremely toxic and causes severe health damages, such as cardiovascular and neurological diseases, as well as hazard for pregnant women.

In this work, a procedure for on-site determination of Hg and CH_3Hg was developed; in particular, attention was focused on some key aspects such as ease, portability, and low cost. The technique adopted was Anodic Stripping Voltammetry (ASV) using a Solid Gold Electrode (SGE) as working electrode. Firstly, the pre-treatment phase, which is usually accomplished with laboratory microwave ovens, was carried out by heating at bain-marie in a food warmer; this treatment is compatible with field analysis. Aliquots of samples were treated with suitable extractants for 20 minutes at 50 ± 10 °C: for the determination of total Hg, a mixture of $HNO_3/H_2O_2=1:1$ was adopted, while for speciation purposes, *i.e.*, to distinguish between Hg_{IN} and CH_3Hg , concentrated HCl was chosen. Then, the solutions so obtained were filtered and analysed with a portable potentiostat.

The solutions for the determination of total Hg were analysed directly. For speciation study, the solutions were flown through a home made column packed with Amberlite XAD 1180N synthetic resin modified with an ionic liquid, [trihexyl(tetradecyl)phosphonium chloride, CYPHOS 101] with strong affinity for anionic $Hg_{in}Cl_4^{2-}$ complexes. The column, named CYXAD, permitted the separation of the two Hg species: the resin held Hg_{IN} , whereas CH_3Hg was not retained and was collected in a test tube. Then the former was eluted with 5 mL of 6 M HNO_3 . The two aliquots, containing CH_3Hg and Hg_{IN} , respectively, were analysed separately by ASV. The method was validated by analysing a standard reference material, Tuna Fish BCR-46,3.

This approach was employed for the analysis of pet food samples provided by the Istituto Zooprofilattico Sperimentale del Piemonte, Liguria e Valle d'Aosta and of fresh fish samples

purchased in a local fish market. The technique was found to be suitable for the determination of different forms of Hg, with several advantages in terms of speed, ease, small amount of sample required and possibility to carry out on-site analysis.

References

- [1] A. Giacomino, A. Ruo Redda, S. Squadrone, M. Rizzi, M. C. Abete, C. La Gioia, R. Toniolo, O. Abollino, M. Malandrino, Anodic stripping voltammetry with gold electrodes as an alternative method for the routine determination of mercury in fish. Comparison with spectroscopic approaches, *Food Chem.*, **221** (2017), 737–745.
- [2] A. Giacomino, A. Ruo Redda, R. Caligiuri, P. Inaudi, S. Squadrone, M. C. Abete, O. Abollino, S. Morandi, E. Conca, M. Malandrino, Development of an easy portable procedure for on-site determination of mercury and methylmercury, *Food Chem.*, **342** (2021), 128347.