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Overcoming traditional water sampling through analyte sampling and preparation in water monitoring

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The traditional analytical workflow typically involves three main steps: sampling procedure, sample preparation, and analyte quantification. Although often overlooked, the sampling procedure can significantly influence the accuracy of the analysis. In water analysis, the sampling procedure is conventionally performed by collecting a representative portion of the material to be sampled into a bottle containing a pre-added preservative, then storing the sample conveniently before quantification. Additionally, at the lab, the sample needs to undergo a preparation procedure to favor the analyte quantification. While these procedures have been widely used for the past decades, they present several challenges, which can affect sample integrity and consequently may introduce some uncertainty in the analyte quantification. Sampling and sample preparation are two limiting steps that may alter sample composition due to temperature variation, UV irradiation, microbial activity, oxygen exposure, changes in pH, and the use of organic solvents that might alter chemical equilibrium and the sample composition. Additionally, from a logistical point of view, this conventional procedure also presents some challenges inherent to water sampling at the site and, at the lab, some constraints associated with conservation, storage and preparation of a large volume of water and a high number of samples.

To overcome these limitations, and within the scope of the project Aqua_Smart, novel miniaturized water sampling strategies based on solid phase extraction were designed. This approach offers a promising advantageous alternative to the conventional sampling, transport and storage of a high volume of water samples. In this context, the objective was to develop miniaturized extraction procedures for metal ions sampling at the water source for subsequent transport to the laboratory for quantification. An additional goal is to integrate in the sampling procedure also sample pre-treatment and, this way, simultaneously enable the cleanup of the sample matrix and analyte enrichment. These innovative strategies not only enhance analytical performance but also support environmental sustainability, making it a valuable tool for water quality monitoring and metal pollution management. Furthermore, the ability to reuse the solid phase extraction sorbent material further improves the method's cost-effectiveness and sustainability.

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