Electrochemical detection of Arsenic (III) ions using bacteria derived bioactive compounds

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Arsenic is one of the 10 heavy metals of greatest public health concern, according to the World Health Organization (WHO) [1]. A simple, fast and cost-effective electrochemical approach is here reported for the selective and quantitative detection of arsenic (III) ions in irrigation water starting from bacteria derived bioactive compounds. The exopolysaccharide (EPS B3-15) produced by the thermophilic, heavy metal tolerant Bacillus Licheniformis B3-15, and the biosurfactant obtained from Bacillus horneckiae SBP3 (BS- SBP3) have been used as sensitive elements for the electrochemical detection of As3+ due to their known recognition abilities towards this toxic ion, their thermophilic properties and stability in harsh conditions [2]. The covalent functionalization of screen-printed gold electrodes with these bioactive compounds demonstrated to be advantageous to selectively detect As3+ in contaminated waters. Electrochemical measurements, performed for the developed sensors SPGE-EPS-B3-15 and SPGE-BS- SBP3, at the normal range of pH in surface water systems (6.5–8.5) demonstrated a higher sensitivity towards As3+ with respect to the bare electrode, also in the presence of other competing ions, such as Al3+, Bi3+, Ni2+ and Pb2+,with very low limits of detection (0.19 nM for SPGE-EPS-B3-15 and 0.03 nM for SPGE-BS- SBP3), which are below the legal limits for these heavy metal ions in drinking water (10 μg/L) (Fig. 1). The reported sensitivity was 1.8 μA nM–1cm–2 for SPGE-EPS-B3-15 and 17.5 μA nM–1cm–2 for SPGE-BS- SBP3. The preferred detection abilities of the chosen bioactive compounds towards As3+ ions have been also confirmed by complete conformational analysis, using a combination of Molecular Dynamics (MD) and Density Functional Theory (DFT) studies. Figure 1. Modified screen-printed electrode for As3+ detection. References [1] J.O. Fatoki et al., J. Hazard. Mater. Adv. 5 (2022) 100052. [2] A. Spanò et al., J. Mar. Sci. Eng. 11 (2023) 1–14.