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A Nanozyme Biosensor for Uric Acid Detection Based on a Designed Uricase-Mimicking Mini-Protein Encapsulated in ZIF-8

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ABSTRACT

This work presents the use of encapsulated mini protein 20 mimicking uricase (mp20)-zeolitic imidazolate framework-8 (ZIF-8) as a bioreceptor for the development of a nanozyme-based electrochemical biosensor for uric acid detection. The electrochemical performance of the biofunctionalized mp20@ZIF-8 on the reduced graphene oxide/screen-printed carbon electrode (rGO/SPCE) was investigated by optimizing operating parameters such as pH, deposition potential, and deposition time using a central composite design-response surface methodology (CCD-RSM). The quadratic regression model was developed to correlate the combination of each variable to the oxidation current density as a response. A significant effect on current response was observed under optimized conditions of pH of 7.4 at -0.35 V deposition potential and 56.56 s deposition time, with $p < 0.05$ for each interacted factor. The obtained coefficient of determination (R^2) value of 0.9992 indicated good agreement with the experimental finding. The developed nanozyme biosensor (mp20@ZIF-8/rGO/SPCE) exhibited high selectivity in the presence of the same fold concentration of interfering species with a detection limit of $0.27 \mu\text{M}$, over a concentration range of 1 to $34 \mu\text{M}$. The practicality of the tailored biosensor in monitoring uric acid in human serum and urine samples was validated with high-performance liquid chromatography (HPLC) and a commercial uric acid meter. Hence, nanozyme-based is a promising platform that offers a rapid, sensitive, selective, and low-cost biosensor for the non-enzymatic detection of uric acid in biological samples.

Keywords: *Uric acid, ZIFs, Uricase, Nanozymes, RSM.*