Selective determination of bortezomib with a plant-based nanoflower-modified electrochemical MIP sensor

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Bortezomib (BOR) is the first developed proteasome inhibitor and is used to treat multiple myeloma, mantle cell lymphoma, and gastrointestinal stromal tumors [1,2]. This study reports the design of a molecularly imprinted polymer (MIP)-based electrochemical sensor using green-synthesized saffron-based copper nanoflowers (CuNFs) to selectively and sensitively determine BOR in biological and pharmaceutical samples. The MIP structure was fabricated on the glassy carbon electrode (GCE) surface via the photopolymerization process (365 nm UV light, 190 min). The MIP components include template drug BOR, functional monomer 2-Acrylamido-2-methyl-1-propane sulfonic acid (AMPS), cross-linker, basic monomer, initiator, and CuNFs for improved porosity. Factors affecting the MIP design (nanoflower type and amount, functional monomer ratio, dropping volume, removal and rebinding processes) were optimized step by step. Electrochemical and morphological characterization studies for MIP-based sensor surfaces and CuNFs were performed by scanning electron microscopy (SEM), energy dispersive X-ray analysis (EDX), X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), atomic force microscopy (AFM), cyclic voltammetry (CV), and electrochemical impedance spectroscopy (EIS) techniques. The developed sensor gave a linear response for the standard solution and serum sample in the 0.25 – 2.5 pM concentration range. The limit of detection (LOD) and limit of quantification (LOQ) values were between 29 and 169.3 fM. The recovery analysis in serum and injection powder samples proved the sensor's applicability and accuracy. Furthermore, selectivity studies using four metabolites of BOR demonstrated the sensor's superior selectivity performance. Additionally, the interference-free performance was confirmed even in the presence of a 1000-fold concentration of interference agents. Consequently, this newly developed sensor can be used as an advantageous method for highly selective, sensitive, and reliable determination of BOR.

References

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