ABSTRACT

The rapid and accurate determination of lactoferrin (LF), an iron-binding glycoprotein and a valuable biomarker for human health, has recently gained significant attention in biomedical diagnostics, nutrition measurements, and food quality control. Although conventional methods are reliable, they are often expensive, tedious, and unsuitable for point-of-care testing. To overcome these challenges, an electrochemical immunosensor was designed by incorporating ferrocene into a carboxymethyl-β-cyclodextrin metal-organic framework (CM-β-CD MOF). CM-β-CD MOF was used as a highly porous and biocompatible surface to immobilize antibodies, whereas ferrocene was used as a redox-active catalyst to enhance the electrochemical signal. The immunosensor was conjugated on a graphite pencil electrode via EDC/NHS coupling chemistry to ensure that antibodies remain intact. Fc-CM-β-CD MOF structural and physicochemical properties were confirmed through FTIR, XRD, SEM, TGA, zeta potential and dynamic light scattering (DLS). Electrochemical characterization showed a broad linear detection range 0.01-1000 ng/mL with a limit of detection (LOD) of 0.0062 ng/mL. The platform also demonstrated high selectivity against interferents, with great reproducibility (RSD < 1%) and stability over 12 days. Its analytical reliability was validated through successful detection of lactoferrin in saliva and milk samples, with recovery rates ranging from 98–102%. In comparison to conventional assays, the proposed Fc-CM-β-CD MOF immunosensor offers a low-cost, fast, and portable approach for sensitive lactoferrin quantification. These results highlight its clinical diagnostics and practical food safety monitoring.