IMMOBILIZATION OF DYE-DECOLORIZING PEROXIDASE ON MAGNETIC NANOPARTICLES: A DUAL-FUNCTIONAL BIOCATALYST FOR MYCOTOXINS DEGRADATION AND HYDROGEN PEROXIDE DETECTION

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The occurrence of multiple mycotoxins poses severe threats to human and animal health and leads to significant economic losses. Therefore, there is an urgent need to explore efficient and environmentally friendly approaches for detoxifying mycotoxins in food and feedstuffs. Dye-decolorizing peroxidases (DyPs), a newly discovered heme peroxidase family, have shown promising catalytic degradation activity against mycotoxins. In this study, the dye-decolorizing peroxidase RhDypB from *Rhodococcus jostii* was successfully expressed in *Escherichia coli*. Additionally, Fe_3O_4 nanoparticles were prepared and modified with chitosan to serve as a carrier for immobilizing of the enzyme RhDypB. The immobilized enzyme RhDypB exhibited excellent catalytic degradation efficiency towards aflatoxin B1 (AFB_1) and zearalenone (ZEN), resulting in the compounds aflatoxin Q_1 (AFQ_1) and 15-OH-ZEN, respectively. Furthermore, the immobilized enzyme matrix Fe_3O_4@CS@RhDypB demonstrated high efficiency in degrading AFB_1 and ZEN with the presence of Mn^{2+} and H_2O_2, and the degradation rates of these two mycotoxins reached 85.61% and 86.52%, respectively. The immobilized enzyme RhDypB also exhibited remarkable storage stability, which retaining the degradation rates of 43.11% and 52.67% for AFB_1 and ZEN respectively after 10 days of storage at 4°C. Moreover, we developed a novel and rapid colorimetric method for hydrogen peroxide (H_2O_2) detection using the immobilized enzyme as a biosensor. The biosensor displayed a linear detection range of 5-50 μmol/L for H_2O_2, with a detection limit of 3.3 μmol/L. Compared to existing methods, the immobilized enzyme demonstrated a significantly shorter reaction time of only 5 minutes. Overall, this work developed a dual-functional biocatalyst for efficient mycotoxins degradation and hydrogen peroxide detection.

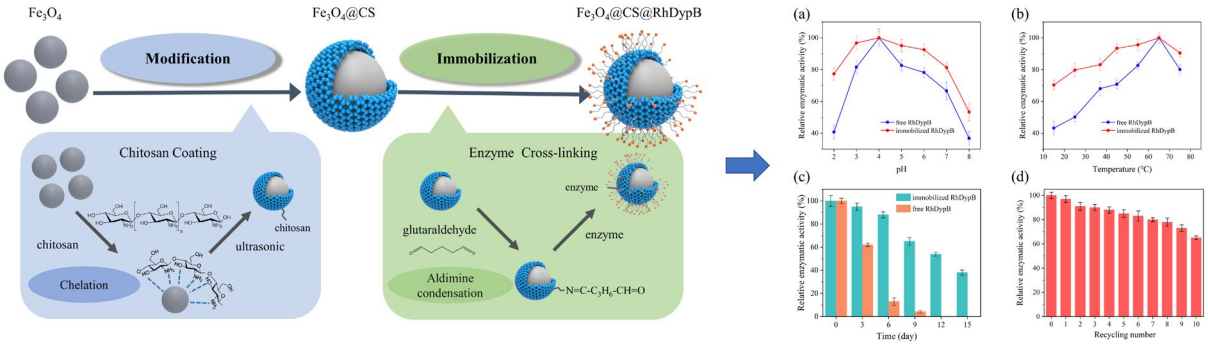

Figure 1 – Schematic illustration of Fe_3O_4@CS@RhDypB preparation and comparison study on enzymatic properties of free and immobilized enzymes