Artificial Hydrolase based on Self-assembled Peptide and Their Potential Applications

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Abstract

There is a great demand for the development of synthetic systems for mimicking bioinspired chemical reactions without utilizing complex enzymes in their native state. Peptide-based nanomaterials offer significant potential as a component for the construction of artificial enzymes. In this study, we investigated the catalytic activity of self-assembly of three tripeptides, P1, P2, and P3 as a hydrolase model. Here, self-assembled peptide P3 has shown the highest catalytic activity with a chromogenic substrate, p-nitrophenyl acetate that gets hydrolysed into p-nitrophenol. Moreover, our findings indicate that the catalytic activity of peptides has been increased with an increase in pH and temperature levels. As similar to native enzyme, these peptide-mimics have shown different specificity towards a series of substrates. By employing rheological studies of peptide hydrogels, we confirm that the strength of the hydrogel of peptide P3 with the highest catalytic activity is the least among all the three tripeptides. Consequently, it indicates that the strength of peptide hydrogel is inversely proportional to the catalytic activity of peptide hydrogel. The viability of HEK-293 cells remained largely unaffected by elevated peptide concentrations, indicating that these molecular systems exhibit substantial biocompatibility. Overall, this study provides insights into how the positioning of histidine residue modulate the catalytic activity of all three fmoc-based tripeptides.

Keywords: Hydrolase, self-assembly, peptide, hydrogel, catalysis, kinetics, biocompatibility.