Huge enhanced activity of the alditol oxidase by a novel method based on the mechanically interlocked dimmer synthesized in vivo

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Abstract

Topology engineering is an attractive approach for tailoring protein properties without varying their native sequences. To explore whether concatenation allow, Herein, we report a dramatic improvement of catalytic efficiencies of alditol oxidase by catenanes assisted by synergy between mechanically interlocking p53dim and highly efficient SpyTag/SpyCatcher cyclization. Mechanical interlocking leads to considerable activity enhancement than that achieved by point mutation. Kinetic analysis demonstrates that the substrates affinity and catalytic efficiency of alditol oxidase catenanes(catAldO) towards glycerol respectively have 6.7-fold and 5.5-fold improvement compared with the wild-type AldO. We envisioned that mechanically interlocked alditol oxidase may shorten the transfer distance of electrons between subdomains and accelerate FAD cofactor redox regeneration, thus improving enzyme catalytic activity. Surprisingly, concatenation of alditol oxidase not only increase the catalytic efficiency towards glycerol, but also exhibit a broad biocatalytic reinforcement. Mechanical interlocking provides a convenient and efficient approach for multi-domains enzyme concatenation, with potential to greatly enhance the catalytic efficiency of biocatalysts. It needs more verification in other enzymes.

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