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Dimethylallyl tryptophan synthase RePT from Rasamsonia emersonii catalyzes prenylation on tryptophan, tyrosine, and plant phenolics

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PURPOSE OF THE ABSTRACT

Dimethylallyl tryptophan synthases (DMATSs) are aromatic prenyltransferases (PTs) that catalyze the transfer of a prenyl (isoprenoid) moiety from a donor to an aromatic acceptor. Aside from their natural role in prenylating tryptophan derivatives in fungal indole alkaloid biosynthesis, DMATSs also act on structurally diverse aromatic substrates [1]. This capability makes DMATSs a potential biotechnological tool to produce biologically active compounds in a wide range of applications, such as antimicrobial plant phenolics [2].

Our study explored the substrate scope and product profile of a recombinant RePT, a novel DMATS from Rasamsonia emersonii, a thermophilic fungus (Figure 1). RePT was successfully produced via a His6-SUMO-RePT construct, showing a molecular weight of 66.4 kDa with 99.1% purity. Among a variety of (plant) aromatic substrates, RePT showed the highest substrate conversion for L-tryptophan and L-tyrosine (>90%), both yielding two mono-prenylated products. Eight phenolics from diverse phenolic subclasses were accepted with a noticeable conversion (>10%) with three stilbenes showing the highest conversion: oxyresveratrol (55%), pinostilbene (39%), and resveratrol (37%). Besides stilbenes, also (+)-catechin, (-)-epicatechin, coumestrol, (±)-equol, and phloretin showed 11-25% conversion. The position of prenylation by RePT on L-tryptophan was determined using 1H, 13C, and 2D-NMR spectroscopy to be either C7-prenylation (80% relative abundance), or reverse N1-prenylation (20%). For plant phenolics, the position of prenylation as annotated using MS2 fragmentation patterns, showed mainly mono-O-prenylation. Moreover, RePT was tolerant to organic solvents and to some extent to a higher temperature, yielding higher than 90% L-tryptophan conversion in the presence of 20% (v/v) methanol or DMSO, or at 50°C. Our findings indicate that RePT may be a promising biocatalyst with potential applications in generating valuable bioactive prenylated aromatics for food, cosmetic, and pharmaceutical industries.

FIGURES

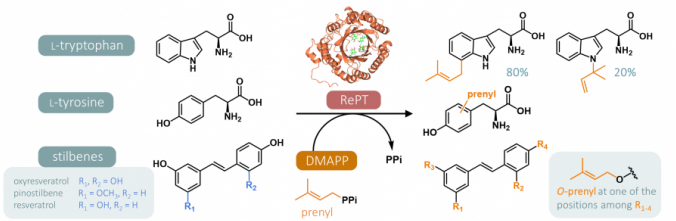

FIGURE 1

Figure 1.

Prenylation of aromatic compounds by RePT in the presence of dimethylallyl pyrophosphate (DMAPP) as a prenyl donor. The three-dimensional structure of RePT is displayed with the strictly conserved four tyrosine residues among DMATSs (represented as green

FIGURE 2

KEYWORDS

DMATS | prenylation | plant phenolics | stilbenes

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