7-dimethylallyltryptophan synthase 2.5.1.80

1 Nomenclature

EC number
2.5.1.80

Systematic name
dimethylallyl-diphosphate:L-tryptophan 7-dimethylallyltransferase

Recommended name
7-dimethylallyltryptophan synthase

Synonyms
7-DMATS <1,2> [1,3]
dimethylallyltryptophan synthase <1> [3]

2 Source Organism

<1> *Aspergillus fumigatus* [3]
<2> *Aspergillus fumigatus* (UNIPROT accession number: A8JY03) [1,2]

3 Reaction and Specificity

Catalyzed reaction
dimethylallyl diphosphate + L-tryptophan = diphosphate + 7-(3-methylbut-2-enyl)-L-tryptophan

Reaction type
alkenyl group transfer

Substrates and products
- **S** dimethylallyl diphosphate + 1-methyl-L-tryptophan <2> (Reversibility: ?) [1]
- **P** diphosphate + 1-methyl-7-(3-methylbut-2-enyl)-L-tryptophan (<2> 35.8% of the yield with L-tryptophan [1])
- **S** dimethylallyl diphosphate + 11-methyl-DL-tryptophan <2> (Reversibility: ?) [1]
- **P** diphosphate + 11-methyl-DL-7-(γ,γ-dimethylallyl)tryptophan (<2> 19.1% of the yield with L-tryptophan [1])
- **S** dimethylallyl diphosphate + 11-methyl-DL-tryptophan <1> (<1> tandem incubation of dimethylallyltryptophan synthases FgaPT2 and 7-DMATS (EC 2.5.1.34 and EC 2.5.1.80) leads to the production of diprenylated in-

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dole derivatives. Yield of diprenylated product: 33.5% (FgaPT2 followed by 7-DMATS), 4.8% (7-DMATS followed by FgaPT2) [3]) (Reversibility: ?) [3]

P ?

S dimethylallyl diphosphate + 4-methyl-DL-tryptophan <2> (Reversibility: ?) [1]

P diphosphate + 4-methyl-7-(3-methylbut-2-enyl)-DL-tryptophan (<2> 89.4% of the yield with L-tryptophan [1])

S dimethylallyl diphosphate + 5-bromo-DL-tryptophan <2> (Reversibility: ?) [1]

P diphosphate + 5-bromo-7-(3-methylbut-2-enyl)-DL-tryptophan (<2> 7.2% of the yield with L-tryptophan [1])

S dimethylallyl diphosphate + 5-fluoro-L-tryptophan <2> (Reversibility: ?) [1]

P diphosphate + 5-fluoro-7-(3-methylbut-2-enyl)-L-tryptophan (<2> 10.7% of the yield with L-tryptophan [1])

S dimethylallyl diphosphate + 5-hydroxy-L-tryptophan <2> (Reversibility: ?) [1]

P diphosphate + 5-hydroxy-7-(3-methylbut-2-enyl)-L-tryptophan (<2> 26.7% of the yield with L-tryptophan [1])

S dimethylallyl diphosphate + 5-methoxy-DL-tryptophan <2> (Reversibility: ?) [1]

P diphosphate + 5-methoxy-7-(3-methylbut-2-enyl)-DL-tryptophan (<2> 13.3% of the yield with L-tryptophan [1])

S dimethylallyl diphosphate + 5-methoxy-DL-tryptophan <1> (<1> tandem incubation of dimethylallyltryptophan synthases FgaPT2 and 7-DMATS (EC 2.5.1.34 and EC 2.5.1.80) leads to the production of diprenylated indole derivatives. Yield of diprenylated product: 10.3% (FgaPT2 followed by 7-DMATS), 3.5% (7-DMATS followed by FgaPT2) [3]) (Reversibility: ?) [3]

P ?

S dimethylallyl diphosphate + 5-methyl-DL-tryptophan <2> (Reversibility: ?) [1]

P diphosphate + 5-methyl-7-(3-methylbut-2-enyl)-DL-tryptophan (<2> 74.8% of the yield with L-tryptophan [1])

S dimethylallyl diphosphate + 5-methyl-DL-tryptophan <1> (<1> tandem incubation of dimethylallyltryptophan synthases FgaPT2 and 7-DMATS (EC 2.5.1.34 and EC 2.5.1.80) leads to the production of diprenylated indole derivatives. Yield of diprenylated product: 24.3% (FgaPT2 followed by 7-DMATS), 0.9% (7-DMATS followed by FgaPT2) [3]) (Reversibility: ?) [3]

P ?

S dimethylallyl diphosphate + 6-fluoro-DL-tryptophan <2> (Reversibility: ?) [1]

P diphosphate + 6-fluoro-7-(3-methylbut-2-enyl)-DL-tryptophan (<2> 33.7% of the yield with L-tryptophan [1])

S dimethylallyl diphosphate + 6-methyl-DL-tryptophan <2> (Reversibility: ?) [1]
P diphosphate + 6-methyl-7-(3-methylbut-2-enyl)-DL-tryptophan (<2> 19.8% of the yield with L-tryptophan [1])
S dimethylallyl diphosphate + 6-methyl-DL-tryptophan <1> (<1> tandem incubation of dimethylallyltryptophan synthases FgaPT2 and 7-DMATS (EC 2.5.1.34 and EC 2.5.1.80) leads to the production of diprenylated indole derivatives. Yield of diprenylated product: 2.6% (FgaPT2 followed by 7-DMATS), 1.5% (7-DMATS followed by FgaPT2) [3]) (Reversibility: ?) [3]
P ?
S dimethylallyl diphosphate + 7-methyl-DL-tryptophan <2> (Reversibility: ?) [1]
P diphosphate + 7-(3-methylbut-2-enyl)-DL-tryptophan + ? (<2> 0.3% of the yield with L-tryptophan [1])
S dimethylallyl diphosphate + D-tryptophan <2> (Reversibility: ?) [1,2]
P diphosphate + D-7-(3-methylbut-2-enyl)-tryptophan (<2> 11.8% of the yield with L-tryptophan [1]; <2> 15.5% of the activity with L-tryptophan [2])
S dimethylallyl diphosphate + D-tryptophan <1> (<1> tandem incubation of dimethylallyltryptophan synthases FgaPT2 and 7-DMATS (EC 2.5.1.34 and EC 2.5.1.80) leads to the production of diprenylated indole derivatives. Yield of diprenylated product: 4.3% (FgaPT2 followed by 7-DMATS), 2.6% (7-DMATS followed by FgaPT2) [3]) (Reversibility: ?) [3]
P ?
S dimethylallyl diphosphate + DL-indole-3-lactic acid <2> (Reversibility: ?) [1]
P diphosphate + 7-(3-methylbut-2-enyl)-DL-indole-3-lactic acid (<2> 4.3% of the yield with L-tryptophan [1])
S dimethylallyl diphosphate + DL-indole-3-lactic acid <1> (<1> tandem incubation of dimethylallyltryptophan synthases FgaPT2 and 7-DMATS (EC 2.5.1.34 and EC 2.5.1.80) leads to the production of diprenylated indole derivatives. Yield of diprenylated product: 35.7% (FgaPT2 followed by 7-DMATS), 16.7% (7-DMATS followed by FgaPT2) [3]) (Reversibility: ?) [3]
P ?
S dimethylallyl diphosphate + L-Trp-Gly <2> (Reversibility: ?) [2]
P diphosphate + L-7-(3-methylbut-2-enyl)-Trp-Gly (<2> 10.9% of the activity with L-tryptophan [2])
S dimethylallyl diphosphate + L-abrine <1> (<1> tandem incubation of dimethylallyltryptophan synthases FgaPT2 and 7-DMATS (EC 2.5.1.34 and EC 2.5.1.80) leads to the production of diprenylated indole derivatives. Yield of diprenylated product: 92.7% (FgaPT2 followed by 7-DMATS), 11.3% (7-DMATS followed by FgaPT2) [3]) (Reversibility: ?) [3]
P ?
S dimethylallyl diphosphate + L-β-homotryptophan <2> (Reversibility: ?) [1]
P diphosphate + 7-(3-methylbut-2-enyl)-L-β-homotryptophan (<2> 28.2% of the yield with L-tryptophan [1])

S dimethylallyl diphosphate + L-β-homotryptophan <1> (<1> tandem incubation of dimethylallyltryptophan synthases FgaPT2 and 7-DMATS (EC 2.5.1.34 and EC 2.5.1.80) leads to the production of diprenylated indole derivatives. Yield of diprenylated product: 31.5% (FgaPT2 followed by 7-DMATS), 6.6% (7-DMATS followed by FgaPT2) [3]) (Reversibility: ?) [3]
P ?
S dimethylallyl diphosphate + L-tryptophan <2> (Reversibility: ?) [1,2]
P diphosphate + L-7-(3-methylbut-2-enyl)-tryptophan
S dimethylallyl diphosphate + L-tryptophan <1> (<1> tandem incubation of dimethylallyltryptophan synthases FgaPT2 and 7-DMATS (EC 2.5.1.34 and EC 2.5.1.80) leads to the production of diprenylated indole derivatives. Yield of diprenylated product: 89.7% (FgaPT2 followed by 7-DMATS), 20% (7-DMATS followed by FgaPT2) [3]) (Reversibility: ?) [3]
P ?
S dimethylallyl diphosphate + L-tryptophan hydroxamate <2> (Reversibility: ?) [1]
P diphosphate + L-7-(γ,γ-dimethylallyl)tryptophan hydroxamate (<2> 4.6% of the yield with L-tryptophan [1])
S dimethylallyl diphosphate + L-tryptophan methyl ester <2> (Reversibility: ?) [1]
P diphosphate + 7-(3-methylbut-2-enyl)-L-tryptophan methyl ester (<2> 7.2% of the yield with L-tryptophan [1])
S dimethylallyl diphosphate + N-acetyl-DL-tryptophan <2> (Reversibility: ?) [1]
P diphosphate + N-acetyl-DL-7-(γ,γ-dimethylallyl)tryptophan (<2> 7.7% of the yield with L-tryptophan [1])
S dimethylallyl diphosphate + N^{α}-methyl-L-tryptophan <2> (<2> i.e. L-abrine [1]) (Reversibility: ?) [1]
P diphosphate + N^{α}-methyl-L-7-(γ,γ-dimethylallyl)tryptophan (<2> 82.2% of the yield with L-tryptophan [1])
S dimethylallyl diphosphate + cyclo-L-Trp-Gly <2> (Reversibility: ?) [2]
P diphosphate + cyclo-L-7-(3-methylbut-2-enyl)-Trp-Gly (<2> 1.8% of the activity with L-tryptophan [2])
S dimethylallyl diphosphate + indole-3-acetic acid <2> (Reversibility: ?) [1]
P diphosphate + 7-(3-methylbut-2-enyl)-indole-3-acetic acid (<2> 10.8% of the yield with L-tryptophan [1])
S dimethylallyl diphosphate + indole-3-butyric acid <2> (Reversibility: ?) [1]
P diphosphate + 7-(3-methylbut-2-enyl)-indole-3-butyric acid (<2> 9.1% of the yield with L-tryptophan [1])
S dimethylallyl diphosphate + indole-3-propionic acid <2> (Reversibility: ?) [1]
P diphosphate + 7-(3-methylbut-2-enyl)-indole-3-propionic acid (<2> 8.5% of the yield with L-tryptophan [1])
S dimethylallyl diphosphate + indole-3-pyruvic acid <2> (Reversibility: ?) [1]

P diphosphate + 7-(3-methylbut-2-enyl)-indole-3-pyruvic acid (<2> 4.8% of the yield with L-tryptophan [1])
S dimethylallyl diphosphate + tryptamine <2> (Reversibility: ?) [1]
P diphosphate + 7-(3-methylbut-2-enyl)-tryptamine (<2> 7.5% of the yield with L-tryptophan [1])
S dimethylallyl diphosphate + tryptamine <1> (<1> tandem incubation of dimethylallyltryptophan synthases FgaPT2 and 7-DMATS (EC 2.5.1.34 and EC 2.5.1.80) leads to the production of diprenylated indole derivatives. Yield of diprenylated product: 11% (FgaPT2 followed by 7-DMATS), 6.3% (7-DMATS followed by FgaPT2) [3]) (Reversibility: ?) [3]
P ?
S Additional information <2> (<2> no substrate: geranyl diphosphate, L-phenylalanine, L-tyrosine [2]) (Reversibility: ?) [2]
P ?

Metals, ions

Ca^{2+} <2> (<2> slight stimulation [2]) [2]
Additional information <2> (<2> addition of divalent cations is not required [2]) [2]

K_m-Value (mM)

0.067 <2> (dimethylallyl diphosphate, <2> pH 7.5, 37°C [2]) [2]
0.137 <2> (L-tryptophan, <2> pH 7.5, 37°C [2]) [2]

4 Enzyme Structure

Molecular weight

65000 <2> (<2> gel filtration [1]) [1]

Subunits

? <2> (<2> x * 53000, calculated [2]) [2]
monomer <2> (<2> 1 * 50000, SDS-PAGE, 1 * 54000, calculated, His-tagged recombinant protein [1]) [1]

5 Isolation/Preparation/Mutation/Application

Purification

<2> (recombinant protein) [2]

Cloning

<1> (expressed as a recombinant protein) [3]
<2> (expression in Escherichia coli, His-tagged protein) [1,2]

Application

biotechnology <1> (<1> the combination of the two dimethylallyltryptophan synthases FgaPT2 and 7-DMATS (EC 2.5.1.34 and EC 2.5.1.80) can be successfully used for chemoenzymatic synthesis of the diprenylated derivatives. The

potential of recombinant enzymes from secondary metabolite biosynthesis as promising tools for the production of designed compounds is demonstrated [3]) [3]

6 Stability

General stability information

<2>, 37°C, absence of substrate, 16 h, 80% residual activity [1]

References

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