2-Succinyl-6-hydroxy-2,4-cyclohexadiene-1-carboxylate synthase

1 Nomenclature

EC number
2.5.1.64

Systematic name
isochorismate:2-oxoglutarate:cyclodieneyltransferase (decarboxylating, pyruvate-forming)

Recommended name
2-succinyl-6-hydroxy-2,4-cyclohexadiene-1-carboxylate synthase

Synonyms
2-succinyl-6-hydroxy-2,4-cyclohexadiene-1-carboxylate synthase-α-ketoglutarate decarboxylase
2-succinyl-6-hydroxy-2,4-cyclohexadiene-1-carboxylic acid synthase
6-hydroxy-2-succinylcyclohexa-2,4-diene-1-carboxylate synthase
SHCHC synthase

CAS registry number
122007-88-9

2 Source Organism

<1> *Escherichia coli* (bifunctional enzyme 2-succinyl-6-hydroxy-2,4-cyclohexadiene-1-carboxylic acid synthase and α-ketoglutarate decarboxylase [1]; strain JRG511 [3]) [1, 3]

<2> *Bacillus subtilis* [2]

<3> *Synechocystis* sp. (PCC 6803 [4]) [4]

3 Reaction and Specificity

Catalyzed reaction
2-oxoglutarate + isochorismate = (1S,6R)-6-hydroxy-2-succinylcyclohexa-2,4-diene-1-carboxylate + pyruvate + CO₂

Reaction type
acyl group transfer
Natural substrates and products
S 2-oxoglutarate + isochorismate <1, 2, 3> (<1,2> the enzyme is involved in the pathway for the biosynthesis of menaquinone [1,2]; <1> early enzyme in menaquinone biosynthesis [3]; <3> menD codes for 2-succinyl-6-hydroxy-2,4-cyclohexadiene-1-carboxylate synthase. menD- mutants lack phyloquinone and are sensitive to high light intensities. In menD- mutants the ratio of photosystem I to photosystem II is reduced relative to wild-type. The lower growth rate and high-light sensitivity of the menD-mutants are attributed to a lower content of photosystem I per cell [4])
(Reversibility: ? <1, 2, 3> [1, 2, 3, 4]) [1, 2, 3, 4]
P (1S,6R)-6-hydroxy-2-succinylcyclohexa-2,4-diene-1-carboxylate + pyruvate + CO₂

Substrates and products
S 2-oxoglutarate + isochorismate <1, 2, 3> (<1> two reactions are identified in the formation of (1S,6R)-6-hydroxy-2-succinylcyclohexa-2,4-diene-1-carboxylate. These are the decarboxylation of 2-oxoglutarate, which results in the formation of succinic semialdehyde-thiamine diphosphate anion, and the addition of succinic semialdehyde-thiamine diphosphate anion to isochorismate with the elimination of the pyruvoyl moiety [1]; <2> the 2-oxoglutarate decarboxylase activity involved is distinct from that of the E1 of the KGDH complex [2]) (Reversibility: ? <1,2,3> [1,2,3,4]) [1, 2, 3, 4]
P (1S,6R)-6-hydroxy-2-succinylcyclohexa-2,4-diene-1-carboxylate + pyruvate + CO₂ <1-3> [1-4]

Specific activity (U/mg)
Additional information <1> (<1> convenient HPLC assay for the study of the overall synthesis of o-succinylbenzoic acid from isochorismate or other substrates, i.e. combined activity of 2-succinyl-6-hydroxy-2,4-cyclohexadiene-1-carboxylate synthase, o-succinylbenzoic acid synthase and putative decarboxylase. The method also has been adapted to separate measurement of 2-succinyl-6-hydroxy-2,4-cyclohexadiene-1-carboxylate synthase plus decarboxylase activity [3]) [3]

4 Enzyme Structure
Subunits
? <1> (<1> x * 69000, a single gene encodes 2-succinyl-6-hydroxy-2,4-cyclohexadiene-1-carboxylic acid synthase and a-ketoglutarate decarboxylase, calculation from nucleotide sequence [1]) [1]

5 Isolation/Preparation/Mutation/Application
Source/tissue
cell extract <2> [2]