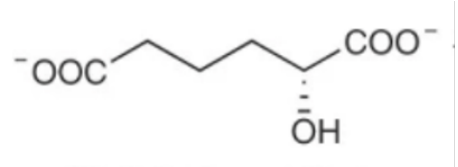
A bio-based method for producing adipic acid by using an enzyme to selectively convert 2-oxoadipate to (R)-2-hydroxyadipate

Unmet Need

Adipic acid (1,4-butanedicarboxylic acid; $COOH(CH_2)_4COOH$), is among the most-produced chemicals worldwide, with approximately 2.5 billion kilograms synthesized annually and a global market of 8 billion USD. The most typical use for adipic acid is for the synthesis of nylon-6,6 used in upholstery, auto parts, apparel, and other products. Standard industrial methods for adipic acid synthesis are costly and have major drawbacks including consumption of fossil fuels, inefficient yields, and production of greenhouse gases. To address this need, “greener” methods for adipic acid production have been demonstrated, but these methods have not been widely adopted, in part because they depend on large-scale hydrogen peroxide oxidation, or because they couple otherwise environmentally friendly fermentation reactions with non-biological synthetic reactions. There is a need for efficient methods to produce adipic acid that are environmentally friendly.

Technology

Duke inventors have reported an enzyme, and the nucleic acid to encode the enzyme, that can specifically catalyze the conversion of 2-oxoadipate to (*R*)-2-hydroxyadipate. This is intended to be used to as a biological method for producing adipic acid. Specifically, cancer-associated mutations from isocitrate dehydrogenases were applied to homologous residues in the active sites of homoisocitrate dehydrogenases to derive enzymes that catalyze the conversion of 2-oxoadipate to (*R*)-2-hydroxyadipate, a critical step for adipic acid production. The inventors



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Publication(s)

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External Link(s)

• From the lab of Dr. Zachary Reitman
• From the lab of Dr. Hai Yan

demonstrated that the enzyme was specific for 2-oxoadipate; they did not see any activity when incubating with other dicarboxylic acids. They also confirmed with LC/MS/MS studies that they produced only the (*R*) enantiomer.

Other Applications

This technology could be used to generate other chiral chemicals that require the conversion of 1-carboxy-2-ketoacid to 1-carboxy-(*R*)-2-hydroxyacid, or the reverse reaction.

Advantages

- Could enable a less expensive bio-based method for producing adipic acid with fewer environmental impacts than current method
- Completely specific for 1-carboxy-2-ketoacid substrate and generating the (*R*) enantiomer product
- Can be used to catalyze the generation of other industrial chiral chemicals