Synthesis of l-Lactic Acid Based on Conversion of CO2 by Efficient Artificial Photosynthetic Communities

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l-lactic acid is a key component of degradable plastics and an important platform compound used in chemicals, materials, health, and cosmetics. The production using agricultural feedstock causes problems of low economic efficiency and environmental unsustainability. Thus a photosynthetic community comprising Synechococcus elongatus PCC 7942 and Bacillus coagulans LA 204 was constructed to realize green and efficient l-lactic acid production. After verification, the optimal factors (pH=8, temprature=32.5?, S. elongatus:B. coagulans inoculation ratio=10:1) for the community to produce l-lactic acid was determined. Then, by comparing intermediates, glycerol was expected to reroute the carbon flux in the community. After transforming recombinant plasmid pSyn-gpd1-gpp2 into S. elongatus, it could successfully secrete glycerol at the rate of 1134 mg/Lin 6 days. Under optimal pH and temperature, the recombinant S. elongatus significantly increased the l-lactic acid production of the artificial photosynthetic community from 481 mg/L to 1,120 mg/L when inoculated at a ratio of 10:1 with B. coagulans within the experiment period of 5 days. Transcriptomics analysis further revealed excellent metabolic collaboration between the two microorganisms in the community, effectively enhancing photosynthetic electron transport in S. elongatus. The glycerol photosynthetic modules notably improved l-lactic acid production, paving the way forward for more productive options in diversified microbial communities and may open up the possibility of building artificial bio-carbon cycles in a sustainable future.

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