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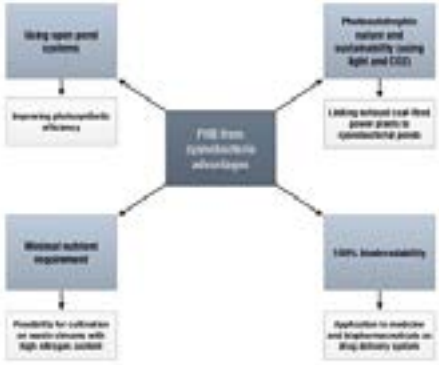
Cyanobacteria as model organism for PHB production

The increasing effect of non-degradable plastic wastes is a growing concern. Polyhydroxybutyrate (PHB) is a storage compound and the raw material for biodegradable plastics with properties comparable to PP. PHB can be completely mineralized into water and carbon dioxide by naturally occurring microorganisms. It is also a biocompatible material and is being studied for its application in biomedical and biopharmaceutical field as biodegradable drug delivery system as it is compatible with mammalian blood and tissue. Currently, PHAs are solely synthesized by heterotrophic bacteria using sugar fermentation. The relatively high costs of raw materials and continuous oxygen supply for the processing make PHAs expensive in comparison to other petroleum-derived plastics. Methodology and theory: The alternative is to use certain oxygenic cyanobacteria as cell factory. Cyanobacteria can store PHB under nutrient (P, N) limitation from renewable and sustainable resources sunlight and CO_2 and due to their minimal nutrient requirement are the most promising host system for PHB production. However the growth rate and the PHB yield stay low. There exists no general method to increase PHB yield in cyanobacteria. This work aims at making cyanobacteria competitive by optimization of growth conditions and by strain selection. Findings: We screen for wild type strains which can naturally accumulate PHB. During our systematic screening we have discovered a cyanobacterium sp. strain which naturally accumulates a high PHB content under N and P limitations in comparison to other existing strains. The improvement of the strain is possible using process engineering and natural mutations. Significance: Our project can develop an economically superior bioprocess to enhance biomass growth and PHB productivity and prove feasibility to use CO_2 for production of biodegradable plastics.



Biography

Maximilian Lackner earned his PhD in 2003 and his habilitation in 2009 from Vienna University of Technology. He has held several senior leadership positions in the polymer industry in Austria and China. Dr. Lackner has founded 5 companies, amongst them one for antimicrobial polymers and one in the area of bioplastics, Lackner Ventures & Consulting GmbH. The company collaborates with JinHui Zhaolong, one of the largest PBAT manufacturers. The research interests of Dr. Lackner include PHA and PBAT for PP and PE replacement, respectively. Lackner Ventures & Consulting GmbH runs a research project to produce PHB from CO_2 and sunlight using cyanobacteria. Dr. Lackner has authored more than 100 scientific articles, a textbook and has edited several reference works, e.g. Springer's "Handbook of Climate Change Mitigation and Adaptation" (2nd edition). He teaches materials science at the University of Applied Sciences FH Technikum Wien.

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