Master Project

Karlsruhe Institute of Technology

Microsystems in Bioprocess Engineering, Institute of Process Engineering in Life Sciences
Karlsruhe Institute of Technology, Fritz-Haber-Weg 2, 76131 Karlsruhe, Germany

Optimization of astaxanthin production with *C. glutamicum* in a two-stage continuous bioreactor cascade

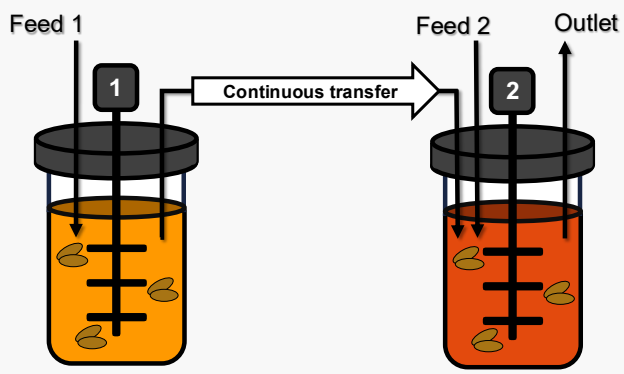
About us: The "Microsystems in Bioprocess Engineering" group at the CIW Faculty of KIT is dedicated to integrating microfluidic technologies into bioprocess research.
The BIOSCALE group is a subgroup within this research unit and focuses on bioprocess development in laboratory-scale stirred-tank reactors (3.7 L). Core activities include microbial cultivation under controlled conditions, process monitoring, and the systematic evaluation of process parameters to better understand and optimize biotechnological production systems. Especially continuous fermentations are a key part of our research area as they provide valuable advantages over more traditional fermentation modes such as lower downtime and higher process parameter control.

Project-Background: Growing demand for high-value compounds independent of fossil resources drives the development of superior bioprocesses. Astaxanthin, a red carotenoid pigment currently used in cosmetics and feed, holds great potential for nutraceutical and pharmaceutical applications due to its strong antioxidant properties. Algal and synthetic production have significant shortcomings though.
In *Corynebacterium glutamicum*, growth, precursor formation, and astaxanthin synthesis are governed by distinct metabolic pathways with different pH optima for growth, precursor and astaxanthin formation. As a secondary metabolite, astaxanthin synthesis benefits from conditions distinct from those driving biomass formation. Prior work established a two-stage, two-reactor cascade of sequential continuous cultivations, separating growth and production phases spatially to allow each to proceed under its optimal conditions for enhanced astaxanthin production efficiency. Different dilution rates and feeding schedules have already been tested to find a direction towards further optimisation.

Project aim: With this newly established continuous setup, surpassing the highest volumetric productivity thus far described in literature based on a fed-batch process, seems possible, leading to the development of a process capable of uniting the benefits of continuous fermentation paired with superior space-time-yields. Possible ways of optimisation include individual per reactor adjustments to glucose feed schedule, dilution rates, and oxygenation.

Your tasks:
- Cultivation of *Corynebacterium glutamicum* in shake flasks and stirred tank bioreactors
- Individual parameter and setup evaluation as well as optimisation
- Carotenoid quantification using HPLC
- Reporting of experiments and results

Your qualification:
- Studying Bioengineering or similar
- Strong interest in process development and optimisation
- Affinity for hands-on tinkering and problem-solving
- High motivation



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