Construction of mini-chemostats for high-throughput strain characterization

To achieve large-scale, high-throughput experiments for systems biology research of microorganisms, reliable data from robust cultivation systems are needed. Chemostats are such systems, ensuring reproducibility and quality by providing a stable, well-controlled environment for the cells. However, many of the available chemostat systems require large amounts of media and are complex to set up and expensive to purchase and maintain. To address these concerns, we developed a mini-chemostat (MC) system with 16 reactors, each at a working volume of 40 ml. Sensors measure dissolved oxygen in the reactor, while OD600 is measured in the outflow. We further developed a CO2 and pH sensor array that can be plugged into the outflow of the reactors. The system was used to characterize yeast physiology at four metabolically different conditions: limitations of glucose, both aerobic and anaerobic, nitrogen, and ethanol. The physiology of yeast cells grown at the four different conditions in the MC system was compared with the yeast cells grown in a DASGIP 1 L system using RNAseq analysis. The results show that the MC system provides the same environmental conditions as the DASGIP system and that the MC system is reproducible between different runs. The system is built to be easily scalable with more reactors and to include more sensors, if available. Our study shows that a robust, reproducible chemostat system for high-throughput and large-scale experiments can be built at low costs.