

Microdroplet-based screening of highly productive microalgal strains under fluctuating light boosts outdoor mass production of algal biomass

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Microalgae are attracting attention as a bio-platform for biological conversion of CO₂ based on its excellent carbon fixation efficiency and production capacity of various useful substances. However, due to the low productivity in large-scale microalgae outdoor cultivation utilizing solar energy, commercialization of the microalgal process is challenging. Fluctuations in light conditions due to changes in cloud cover and solar altitude are considered to be the major causes of cell growth reduction. Here, a novel microdroplet screening system capable of effectively delivering external light conditions to individual cells was introduced to select mutant strains exerting optimal growth performance under fluctuating light conditions. After cell cultivation in the gel microdroplet photobioreactor system, microdroplets were centrifuged and distributed according to their density in a density gradient medium. The separated microdroplets passed through the microchannel to increase the separation efficiency. Consequently, the selected *Chlamydomonas reinhardtii* mutant strain exhibited enhanced biomass and lipid productivity in outdoor mass cultivation using LNG-fired flue gas.