Session: Emerging technologies

Dual-species cyanobacterial biofilms for technical applications

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Cyanobacteria are highly interesting organisms for productive biotechnological applications due to their ability to fix CO_2 and N_2 fueled by sunlight and water. One of the obstacles preventing the large-scale application of such organisms is the low cell density due to light limitation occurring in established photobioreactors. Here, we present a capillary biofilm reactor (CBR) as a novel concept to overcome low cell densities and short reaction stabilities. Thereby we make use of the ability of many organisms to form surface attached biofilms. CBRs are characterized by an exceptional high surface-to-volume ratio and a short light path, the latter being beneficial for optimal light supply.[1] Furthermore, they enable an in principle infinite turn-over number due to their continuous process mode. This study set out to determine biofilm formation ability of 6 cyanobacterial strains in the CBRs with the aim of identifying novel photo-biotech work horses especially suited for such a photobioreactor. Biomass formation, daily surface coverage, biofilm stability, and the impact of nitrogen fixation have been studied. The 'top performer' arising from this study was *Tolypothrix* sp. PCC 7712, which grew up to 62.6 ± 6.34 and 57.5 ± 1.08 $g_{BDW}L^{-1}$ biomass under nitrate-enriched and nitrate-omitted conditions, respectively. Furthermore, it showed the lowest detachment, and highest surface coverage compared to all other species tested including the biotech-model strain *Synechocystis* sp. PCC 6803. Genome sequencing revealed, that it is very closely related to *Tolypothrix* sp. PCC 7601 (ANI> 99.987), which is well-known due to its chromatic light adaptation. Interestingly, despite its close relatedness, PCC 7712 is able to fix atmospheric nitrogen, while PCC 7601 is not.[2]

1 Hoschek et al. (2019). Bioresource technology, 282, 171-178. Doi: 10.1016/j.biortech.2019.02.093

2 Bozan et al. (2022). Biofilm, 100073. Doi: 10.1016/j.bioflm.2022.100073