Session: Tools & modelling

Comprehensive characterization of phototrophic biofilms

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Phototrophic biofilms live embedded in a self-produced matrix of extracellular polymeric substances (EPS) that holds the cells together and act as protection barrier against biotic and abiotic conditions. Phototrophic biofilms are described as a consortium of phototrophic and heterotrophic bacteria, whereby a phototrophic component is clearly present. Microalgae including cyanobacteria are often found in phototrophic biofilms and are also cultivated as single biofilm in lab-scale. However, they offer a wide variety of biotechnological interesting products like biomass itself as natural fertilizer, food supplement and animal food, natural colours, (sulphated) polysaccharides, biodegradable bioplastic (PHB), (new) antimicrobial substances and furthermore. Challenging is their cultivation because phototrophic biofilms need light as energy source and if cultivated in their natural form as biofilms special designed photobioreactors including a surface for biofilm formation. This also includes different characterization techniques for determination of growth for example.

Here, different invasive and non-invasive methods are presented to characterize especially small amounts of phototrophic biofilms in lab-scale and gain as much information as possible. For growth determination optical coherence tomography (OCT) is used to determine biofilm thickness and Pam fluorometry for area growth over chlorophyll a fluorescence. Here, biofilm thickness and biofilm spread could be correlated with cell dry weight over a cultivation period of ten days. Afterwards deviations increased. That means growth can be characterized, but growth rates can’t be determined. A combined downstream process for extraction and determination of pigments (chlorophyll-a, carotenoids), phycobiliproteins (C-phycocyanin, phycoerythrin, allophycocyanin) and EPS including separation in their main components (polysaccharides, proteins, lipids) and further analysation from only one sample was developed. This method will further be extended for characterization of polyhydroxyburate (PHB). For determination of viability SytoxGreen can be used and for vitality a resazurin assay was established that can also be transferred to callus cells as well as heterotrophic bacteria. Characterization of biofilms over cultivation time is important to report product formation, but also to gain information about the state of the cells.