Quorum-quenching Secondary Metabolites Modulate Biofilm Community Composition and Activity Rather Than Prevent Biofilm Formation

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Microorganisms prefer to live in biofilms, aggregates glued together by self-produced biopolymers. In biofilms microbes are much better protected against environmental stress and noxious agents developing complex interactions. In the course of our studies on complex biofilm communities growing on hydrophobic substrates we developed a versatile microcosm approach using mini-dishes, which allows (i) monitoring biofilm communities by Confocal Laser Scanning Microscopy for their ability to colonize hydrophobic substrates, here polychlorinated biphenyl (PCB), (ii) determination of the biodiversity of the biofilm communities by Single Strand Polymorphism Conformation, (iii) assessment of various soil samples for their potential to degrade the substrate by chemical analyses, and (iv) evaluation of the influence of secondary metabolites on biofilm formation and substrate usage. We show here that this microcosm approach allows for screening of secondary metabolites, e.g. S-carvone, cinnamaldehyde, ß-citronellol, eugenol, S(-)-limonene, patulin and thymol, for their impact on the biofilm communities and their metabolic activities. Among the secondary metabolites tested were also some already reported to act as quorum-quenching compounds, e. g. cinnamaldehyde and patulin. Essential oils have been shown to increase the PCB degradation in biodegradation studies and in addition these substances affect biofilm formation. Surprisingly, the PCB-biofilm communities were scarcely influenced by secondary metabolites concerning the participants of the biofilm community, which indicates that the microbial communities were able to overcome – in a functional cooperation – the stress provoked by the substances, and grew on the PCB oil.

Keywords: biofilm, quorum-quenching, community analysis

Acknowledgments: DAAD – German Academic Exchange Service and CAPES