Fungal-bacterial biofilms: their development for novel biotechnological applications

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Abstract The attachment of microbes on biotic or abiotic surfaces to form biofilm structures has a great impact on biodegradation and biosynthesis in nature. Various interactions in such biofilms and their extracellular polymeric substances (EPS) layer make them considerably different in physiology and action, compared to that of their individual microbes in planktonic (free swimming) mode of growth. Expression of new genes is up-regulated in the biofilm cells, due in part to the cellular interactions, compared with the planktonic cells. Formation of fungal-bacterial biofilms (FBB) by bacterial colonization on biotic fungal surface gives the biofilm enhanced metabolic activities compared to monocultures, and perhaps multi-species bacterial or fungal biofilms on abiotic surfaces. Incorporation of a N_2-fixing rhizobial strain to the FBB to form fungal-rhizobial biofilms (FRB) has been shown to improve potential biofilm applications in N-deficient settings and in the production of biofilmed inocula for biofertilizers and biocontrol in plants. Their applications in agricultural and environmental settings, enzyme technology, drug discovery studies and energy research are being investigated. Thus, it has already been shown that the use of the FBB is a promising technology for many applications. This review deals with the different areas in which FBB/FRB have been seen to be applied with successful results as well as the numerous emerging avenues in which they show promising potential.