Investigating Structural and Dynamic Roles of Polymers in Model Levan-Based Biofilm Mixtures

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Non-ionic polysaccharide Levan exhibits rather peculiar non-gelling behaviour in pure aqueous solutions up to high polymer concentrations (60 wt. %) [1] that was found to somewhat depend also on the size of levan molecules [2]. On the other hand, Levan is the major polymeric component in biofilms of bacterium *Bacillus subtilis* subsp. *subtilis* str. NCIB 3610 that appear as firm gel-like bacterial coatings. Obviously, the DNA and proteins as additional minor biofilm components have an important role in structuring and dynamic behaviour of such biofilm systems. Our aim was to investigate individual roles that different polymers play in such structurally and dynamically complex systems. To achieve this goal we exploited various physicochemical techniques as the dynamic rheology, small-angle X-ray scattering, dynamic light scattering, microscopy, densitometry, sound velocity measurements, etc. To be as close to reality as possible, we used Levan and DNA that were isolated directly from the biofilm of *B. subtilis* presented in Figure 1, and the fibril forming protein collagen as a model substitute for the native biofilm protein TasA. Macroscopic rheological measurements revealed that the addition of DNA to levan solution contributed mainly to the increase of viscosity and pseudoplasticity of the system. The addition of protein contributed similarly, but also increased the rigidity of the system. Among other, these findings were complemented by the small-angle X-ray scattering results that provided insight into the structure on a molecular scale [2-4].



Figure 1 Growth of *B. subtilis* biofilm, purification of extracellular polymeric substances (EPS) and isolation of levan.

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