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CONTROLLING THE SIZE AND LINKAGE TYPE OF BIOPOLYMERS DERIVED FROM SUCROSE

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The demand for bio-derived and biodegradable polymers and oligomers is impressively increasing due to societal and environmental concerns. Among the bio-sourced polymers, the a-glucans produced from sucrose using the glucansucrases from the family 70 of glycoside-hydrolases are quite attractive. They can display various structures, in terms of linkage type, molar mass and polydispersity. Their specific traits directly govern their physico-chemical and biological properties at the source of their potential usage in pharmaceutical, cosmetic or agro-food industries. The accessible molecular diversity is thus large and of interest to extend a-glucan applications. However, the fine control of the structures still suffers from a lack of basic knowledge in the mechanistic and structural determinants at the source of the GH70 enzyme specificity.

To fill this gap, we have recently selected different glucansucrases, named DSR-OK, DRS-M and ASR. They synthesize polymers with marked structural differences in terms of size or linkage content. We have solved several 3D structures of these enzymes, unliganded or in complex with different substrates and/or products. The structural analysis of these proteins combined to mutagenesis and biochemical characterization enabled us to identify key determinants of specificity and elaborate mechanistic scenarios for both polymer elongation and linkage type formation.

We will first give an overview of the molecular mechanisms involved in polymer formation and will discuss our recent advances with regard to the complexity of the occurring phenomena. We will also show how our findings can rationally serve to construct mutants and chimera leading to a broader range of bioproducts with well-defined structures.

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