Structural modification of microbial exopolysaccharides and its impact on their functionality

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Exopolysaccharide (EPS)-forming lactic acid bacteria are commonly used for the production of fermented foods and significantly improve their texture and stability. These homo- or hetero-EPS show a high structural heterogeneity, which results in large differences in their macromolecular characteristics. Therefore, it is a major challenge to establish relationships between molecular structure and technofunctional properties. To overcome this drawback, the aim of this study was to produce structurally defined EPS that differ in only one structural feature (e.g. degree of branching, glycosidic linkages, molecular mass) and analyze for their functionality. For this purpose, microbially and enzymatically produced glucans with different backbone architectures were produced, isolated, and treated with branching sucrases to add side chains to specific positions with different degrees of branching. Furthermore, microbially produced hetero-EPS from *Streptococcus thermophilus* were isolated and treated with galactosidases to partially truncate or degrade side chains. The EPS were structurally characterized by NMR spectroscopy, methylation analysis, and enzymatic fingerprinting. Subsequently, all samples were analyzed for their intrinsic viscosity [η] with a rolling ball viscosimeter and size exclusion chromatography coupled with a refractive index and a viscosity detector (SEC-RI/IV). Previous studies showed that that [η] may serve as parameter in aqueous solution to predict the technofunctional potential of EPS (e.g. contribution to gel stiffness) [1].
The results indicate that [η] increases with a higher degree of branching for most of the dextrans, independent from the branching position (α-1,2,6 or α-1,3,6). Regarding the branching position, [η] was higher for α-1,3,6 branched dextrans than for α-1,2,6 and α-1,4,6 branched dextrans. However, the fine structure of the side chains has to be considered. With an increasing portion of α-1,3 or α-1,4 linkages in the backbone of the glucans, the molecules became more compact and [η] decreased. Hetero-EPS generally showed higher [η] than homo-EPS, and again higher [η] were observed with increasing degree of branching and a higher portion of dimeric compared to monomeric side chains.
Our findings contribute to the understanding of EPS functionality and allow for a targeted synthesis of polysaccharides with desired properties.

References:

[1] Nachtigall, C.; Berger, C.; Kovanovic, T.; Wefers, D.; Jaros, D.; Rohm, H. (2019) *Food Hydrocolloids* 97, 105181.

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