Structure-properties of polysaccharides with various branching schemes

Agnès Rolland-Sabaté, F. Grimaud, R. Irague, Sophie Guilois, Denis Lourdin, J.L. Putaux, G. Potocki-Veronese, Alain Buleon

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Authors & affiliations:

Rolland-Sabaté A.[1], Grimaud, F.[2], Irague, R.[2], Guilois S.[1], Lourdin, D.[1], Putaux J-L[3], Potocki-Véronèse, G.[2], Buléon, A.[1]

1) UR1268 Biopolymères Interactions Assemblages, INRA, F-44300 Nantes, France
2) LISBP, Université de Toulouse, INSA-UPS-INP, 135 Avenue de Rangueil, F-31077 Toulouse
3) CERMAV, UPR CNRS 5301, ICMG IFR 2607, BP 53, F-38041 Grenoble cedex 9

* *Corresponding author : Agnes.Sabate@nantes.inra.fr*

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The macromolecular characteristics, thermal properties and film-forming ability of branched glucose-based biopolymers presenting different structures were studied: glycogens, amylopectins and α-D-glucans synthesized in vitro by dextransucrase mutants (dextrans) (Irague et al., 2012). Molar mass and size distributions were determined using asymmetrical flow field flow fractionation (A4F) coupled with multi-angle laser light scattering. The calculated macromolecular conformation and shape in solution were discussed as a function of the branching degree studied by NMR. Dextrans and glycogens showed very broad size distribution whereas an antagonistic trend was observed for amylopectins. The molar mass ranged from $5.2*10^6$ to $1.8*10^7$ $g.mol^{-1}$, $1.2*10^8$ to $4.2*10^8$ $g.mol^{-1}$ and from $7.6*10^7$ to $6.0*10^8$ $g.mol^{-1}$ for glycogens, amylopectins and dextrans, respectively (Rolland-Sabaté et al., 2011; Irague et al., 2012). The branching degree varied from 6 to 8%, 3 to 5% and 3 to 20% for glycogens, amylopectins and dextrans, respectively. Glycogens and amylopectins exhibited a spherical conformation in solution with a Rg/Rh ratio characteristic of dendritic and hyperbranched structures respectively, whereas the series of dextrans exhibited more extended conformations from hyperbranched to comb-like structures. Glycogens and amylopectins had glass transition temperature around 90 °C and 110 °C in average. Dextrans exhibited glass transition temperature between 30 °C and 86 °C and some of them had a good film-forming ability and interesting mechanical properties. As for synthetic polymers, glass transition temperature of these alpha-glucans was shown to depend on both the branching characteristics (type of glycosidic linkage, number, type and topology of branching) and the molar mass. The determination of these structure-properties relations is of considerable interest for the design of biopolymer-based materials for food or non-food applications.

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