

Properties of new dextrans designed using dextransucrase mutants

Romain Irague, Alain Buleon, Laurence Tarquis, Jean Louis Doublier, Claire Moulis, Pierre Monsan, Magali Remaud Simeon, Gabrielle Veronese, Agnès Rolland-Sabaté

▶ To cite this version:

Romain Irague, Alain Buleon, Laurence Tarquis, Jean Louis Doublier, Claire Moulis, et al.. Properties of new dextrans designed using dextransucrase mutants. 5.colloque européen Polymerix 2012, CCB développement. Rennes, FRA., May 2012, Rennes, France. hal-01267885

HAL Id: hal-01267885 https://hal.science/hal-01267885

Submitted on 6 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers. L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Properties of new dextrans designed using dextransucrase mutants

Romain Irague^{1,3,4}, Alain Buléon², Laurence Tarquis^{1,3,4}, Jean louis Doublier² Claire Moulis^{1,3,4}, Pierre Monsan^{1,3,4}, Magali Remaud-Siméon^{1,3,4}, Gabrielle Potocki-Véronèse^{1,3,4}, <u>Agnès</u> <u>Rolland-Sabaté²</u>

¹ INRA, UMR792, Ingénierie des Systèmes Biologiques et des Procédés, 31400 Toulouse, France

² UR1268 Biopolymères Interactions Assemblages, INRA, 44300 Nantes, France

³CNRS, UMR5504, 31400 Toulouse, France

⁴ Université de Toulouse; INSA, UPS, INP; LISBP, 135 Avenue de Rangueil, 31077 Toulouse, France

Biopolymers such as polysaccharides are widely used as thickening, stabilizing or gelling agents. They are generally extracted from plants (e.g. starch, pectin, cellulose) or algae (e.g. agar, carrageenan) but some of them are also produced by microbial fermentations (xanthan, gellan, β -glucans, bacterial cellulose, pullulan, for instance). As they are also of interest as biodegradable materials which could be used for packaging, the ability of plant and algae polysaccharides and microbial polysaccharides to form films has been explored these last years. In this context, α -glucans synthesized from sucrose by the glucansucrases (GS) from lactic acid bacteria of the genus *Leuconostoc*, *Streptococcus*, *Lactobacillus*, *Exigobacterium* and *Weissella* could offer an alternative source of biopolymers. Glucansucrases (GS) are transglucosidases classified into the family 70 of the Glycoside-Hydrolases, that are able to polymerize the D-glucosyl units of sucrose to form high molar mass homopolysaccharides. Depending on the reaction conditions, these versatile biocatalysts are able to synthesize a wide range of α -glucans and oligosaccharides varying in terms of size and osidic linkage type.

The structural and physico-chemical properties of seven high molar mass α -glucans synthesized *in vitro* from sucrose by mutants of dextransucrase DSR-S from *Leuconostoc mesenteroides* NRRL B-512F, obtained by combinatorial engineering, were described to evaluate their applicative potential as bio-sourced materials. These original biopolymers display from 3 to 20% $\alpha(1 \rightarrow 3)$ glycosidic linkages. Using asymmetrical flow field flow fractionation coupled with multiangle laser light scattering (AFFFF-MALLS), it was determined that weight average molar masses and radii of gyration range from 0.76 to 6.02 x 10^8 g.mol⁻¹ and from 55 to 206 nm, respectively. These measurements enabled to clusterize these polymers in three groups, regarding their molar mass, size and branching patterns: (i) Gcn1, which displays the highest \overline{M}_w and a quasi-linear conformation with only 3% $\alpha(1 \rightarrow 3)$ linkages, (ii) Gcn6 and Gcn7, the smallest α -glucans, which contain 15 and 20% $\alpha(1 \rightarrow 3)$ linkages, are highly branched and contain long ramifications, and (iii) the other α -glucans displaying intermediate structures.

Rheological investigation shows that all of these polymers present a classical non-Newtonian pseudoplastic behavior. However, Gcn_ $Dv\Delta 4N$, Gcn2, Gcn3 and Gcn7 form weak gels, while others display a viscoelastic behavior that is typical of entangled polymer solutions. Finally, glass transition temperature T_g was measured by differential scanning calorimetry. Interestingly, the T_g of Gcn1 and Gcn5 are equal to 19.0 and 29.8°C, respectively. Because of this low T_g , these two original dextrans are able to form rubber and flexible films at ambient temperature without any plasticizer addition. The mechanical parameters determined for Gcn1 films from tensile tests are very promising in comparison to the films obtained with other polysaccharides extracted from plants, algae or microbial fermentation. These results lead the way to using these dextrans as innovative bio-sourced materials and biodegradable films.