Geophysical Research Abstracts
Vol. 12, EGU2010-717-1, 2010
EGU General Assembly 2010

Dynamics of water solutions of natural polysaccharides by fast field cycling nmr relaxometry

Alena Prusova (1), Pellegrino Conte (2), Jiri Kucerik (1), Claudio De Pasquale (2), and Giuseppe Alonzo (2)

(1) Brno University of Technology, Institute of Applied Chemistry, Purkyňova 118, Brno – Czech Republic (xcprusova@fch.vutbr.cz), (2) Università degli Studi di Palermo, Dipartimento di Ingegneria e Tecnologie Agro-Forestali, v.le delle Scienze 13, edificio 4, 90128 Palermo – Italy

Cryobiology studies the effect of low temperatures on living systems such as microorganisms and plants. In particular, plants growing in cold or frozen environments can survive such extreme conditions due to the cold hardening process. Hardening is a three step process during which, first, translocation of polysaccharides to the plant roots affects water structure in the cell-soil surface. For this reason, increase of cell-membrane permeability and resistance to temperatures from -5°C to -10°C is achieved. In a second step, chemical alteration of cell membrane arises and resistance to temperatures up to -20°C is obtained. The last hardening step consists in the vitrification of the plant tissues which allow plants to survive at temperatures as low as -50°C.
Since polysaccharides play a very important role in the initial part of the cold hardening process, it is of paramount importance to study the effect of such natural biopolymers on water structure. Here, we present preliminary data obtained by fast field cycling NMR relaxometry on the effect of hyaluronan (an anionic, non-sulfated glycosaminoglycan) on water structure at different concentrations of the polysaccharide. Although hyaluronan is a polysaccharide found exceptionally in animal, human or bacterial bodies, in the present work it was used as a model "pilot" compound. In fact, it has an unique ability to hold water and it contains both polysaccharide and protein-like acetamido functionalities. For this reason, hyaluronan promotes the future research on other plant biopolymers such as, for instance, starch and other very specific proteins.
Results revealed that different water-structure systems surround the molecule of hyaluronan in diluted and semidiluted systems. Namely, at the lowest hyaluronan concentration, three hydration shells can be recognized. The first hydration shell is made by bound water (BW) which is strongly fixed to the hyaluronan surface mainly through electrostatic interactions. A second hydration shell contains water molecules, also recognized as partly-bound (PBW), which are not directly interacting with the hyaluronan chains but with BW. Finally, water molecules, which dynamics is resembling that of the pure and undisturbed water, are indicated either as a bulk water or free water (FW). As hyaluronan concentration is increased the third FW hydration shell is lost and all water molecules are affected by the presence of hyaluronan molecules.
This work showed the great potential of FFC-NMR relaxometry in revealing water nature in polysaccharide solutions and the possibility for future applications on complex biological systems.

Acknowledgements
A.P. gratefully acknowledges a bilateral Erasmus project between Brno University of Technology and University of Palermo which provided grant sustainment for working in Italy. Ministry of Education of the Czech Republic, project MSM 0021630501 is also acknwledged. This work was partially funded by Ce.R.T.A. s.c.r.l. (Centri Regionali per le Tecnologie Alimentari; Italy). Authors kindly acknowledge Dr. Vladimír Velebný (CPN company, Dolní Dobrouč, Czech Republic) for providing of hyaluronan sample.