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Abstracts

Hydrodynamics and Structural Organization of Polysaccharides in Aqueous Solutions of Gelatin

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ABSTRACT

The study is aimed on the dynamics, structure and interactions in binary systems based on gelatin and one of two polysaccharides, κ-carrageenan and sodium alginate, by means of NMR and IR spectroscopy techniques. The gelation temperatures are determined as well as molecular structure of studies systems is characterized.

Introduction

The applications of native gelatin in different technologies have definite restrictions determined by the gelation rate, thermal stability and rheological properties. In this case it is necessary to modify gelatin as a gelator. One of approaches consists in addition of biopolymers compatible with gelatin, for example to use polysaccharides as co-gelators. Their compatibility with gelatin is provided by interaction of charged gelatin and polysaccharide macroions leading to formation of (bio)polyelectrolyte complexes. The latter are capable for self-organization and gelation under a variety of external conditions. This opens new possibilities for modification of rheology, melting temperature, gelation rate, and microstructure of gelatin-based products in its combined application with different ionic polysaccharides.

The present study is aimed on the dynamics, structure and interactions in binary systems based on gelatin and one of two polysaccharides, κ-carrageenan and sodium alginate, by means of NMR and IR spectroscopy techniques.

Research Methods

^{1}H NMR diffusion measurements were carried out in the temperature range from 50 to 10 °C on a Bruker AVANCE400WB spectrometer operating at 400.27 MHz. Diffusion experiments were performed using a stimulated echo sequence. The relaxation delay was set to 10 s. The amplitude of the pulsed field gradient was varied in 32 to 54 increments. The diffusion time was

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changed from 31 to 360 ms. For relaxation measurement the pulse sequences tlir and cpmg — the inversion-recovery for T_1 and KPMG for T_2 were used.

Infrared spectra were collected on an IR-Affinity1 (Shimadzu) FTIR spectrometer (one-fold incomplete internal reflection with Ge crystal) in the range of 4000–1000 cm^{-1} at 8.0 cm^{-1} resolution. All reported spectra are the averages of 256 scans. The corresponding buffer baseline was subtracted from each spectrum, and a smoothing has been applied.

Results

The analysis of FTIR spectra for binary systems of gelatin with both of polysaccharides, κ-carrageenan and sodium alginate, showed the alteration of protein side chain conformation. Apparently it seems that the decrease of peptide group hydration and the increase of stability of protein helical conformation take place as a result of protein–carbohydrate interactions.

For binary systems of gelatin with polysaccharides the temperature dependence of diffusive decays shows their drastic changes in comparison with the decays in pure unary solutions of protein or carbohydrate. The relaxation measurements turn out to be not sensitive to gelation processes in all systems. We determined hydrodynamic dimensions of biopolymer particles. For example, the size of gelatin coil in 1% gelatin solution was equal to 40 nm, the distance between polymer net knots in the gel state is about 75 nm.

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