The project goal is to investigate molecular dynamics of water in hydrocolloids suspensions used in food industry. Hydrocolloids are polymers of biological or synthetic origin with of a large number of hydroxyl groups, which noticeably increases their hydrophilicity. These substances are widely used in food processing technologies as gelling agents, thickeners or fat and saccharose replacers. Most of descriptions of hydrocolloids usually present idealized systems but one has to keep in mind that they are natural products (or derivatives of such) made up of mixtures of molecules of different molecular weights, conformations, or even structures. A useful technique to study the state of water in foods is nuclear magnetic resonance (NMR). It provides fast, sensitive and noninvasive determination of molecular mobility of water in complex systems. Several aspects of biopolymer hydration such as total water content, bound water capacity, mobility and associated binding mechanisms can be revealed with standard NMR experiments. A rheological characterization of gels can be also performed using NMR techniques, usually based on spatially-resolved measurements of velocity using pulsed field gradient (PFG) NMR data. This project, however, will benefit from nuclear spin relaxation studies (relaxometry) performed in a remarkable broad frequency range from about 4 kHz to 120 MHz (for ^{1}H). The so-called Field Cycling (FC) NMR is a powerful tool of "molecular rheology" accessing the microscopic processes underlying macroscopic behaviour of complex fluids (Hofmann et al. 2015).

The aim of the proposal is to get insight into dynamical properties of hydrocolloid gels revealing the underlying motional mechanisms and characterizing them quantitatively. The planned investigations are focused on following topics:

a) Dynamics of simple hydrocolloid systems based on agar, starch, gelatin, pectin, alginate and carrageenan dispersed in water. The investigations will search for correlations between concentration of the polymer and/or temperature and dynamical properties of the system
b) Dynamics of hydrocolloids with additives: cations and sugars. It is already known that such additives alter the gelling properties of polymers. It is expected that the dynamical properties of water will change when the bonding in polymer matrix gets affected by other molecules.
c) Synergistic viscosity effect of non-gelling thickeners (hyaluronan, guar gum, xanthan gum, hydroxyethylcellulose) added to regular (gelling) hydrocolloids
d) Changes in hydrocolloidal systems occurring during hydration – rehydration cycles.
e) Time-stability of gel systems

The results will broaden our understanding of processes taking place during food production, thermal processing and storage.