

ABSTRACT

In the present master thesis, we study the molecular dynamics as well as the phase transitions in the case of collagen-water systems, over a wide range of hydration levels of the fibrous protein.

The aim of this work was to investigate the degree to which the addition of water to native samples affects the dynamic and thermal response of both, collagen and water. Especially in the case of water, it was found that its dynamic behavior varies, depending on its spatial localization within the protein structure.

The experimental methods used for this purpose include Differential Scanning Calorimetry (DSC), Thermally Stimulated Polarization Currents (TSDC), Dielectric Relaxation Spectroscopy (DRS) and Equilibrium Sorption Isotherms (ESI). These are techniques mostly used in polymeric materials and for this reason collagen was treated as a natural biological polymer, consisting of a sequence of monomers -amino acids -, linked together in order to form the polypeptide chain.

Using ESI results it became feasible to estimate the percentage of water molecules occupying the primary hydration sites -first hydration layer- at room temperature. At the same time an hysteresis loop was recorded during the desorption process.

Crystallization and melting events concerning dry or hydrated collagen samples were observed by the DSC technique. Fluctuations in temperature and enthalpy corresponding to these phase transitions and directly associated with the change of water content, were also recorded. No glass transition was detected in the experimental temperature range.

Dielectric spectroscopy measurements -(TSDC, DRS)- allowed the identification of several relaxation modes. Their evolution with hydration level as a function of temperature and frequency, provided information about the dynamics of both collagen and water molecules loosely or tightly bound to its structure, attributing new properties to the protein.