

Alzheimer's disease, Parkinson's disease and type II diabetes are well known disorders that affects millions of people every year. All of these conditions have one thing in common. Proteins or short peptides which are normally present in healthy cells start to aggregate and form fibrillar superstructures: amyloids. Taken altogether, the process leads to the formation of toxic compounds, interferes with delicate biochemical balance and even can cause deaths of the cells. In all of these illnesses the same characteristic phenomenon takes place and as the result they are referred to as Protein Misfolding Diseases.

The main aim of the studies is to get deeper insight on the molecular level into the peptide fibrillation process. Over the past decade the progress of the knowledge in this subject was remarkable but still many questions remain without answers. In this project the unique approach was undertaken. The role of the water in the amyloidogenesis is in the focal point of the work.

The water plays the central function for all living creatures on Earth and shape the biochemical process in every single cell of the human body. The question is what is its exact significance in the protein fibrillation? Would it be possible to change the efficiency of amyloidogenesis by the alternation of the structure of this essential solvent? This second task can be easily tested *in vitro* by the addition of the low molecular compounds, so called osmolytes, which posses the ability to modify the structure of the surrounding solvent.

For the purposes of this investigation the variety of the top-notch techniques are used i.e. Fourier-Transform Infrared Spectroscopy, Atomic Force Microscopy, Circular Dichroism in the Ultraviolet region of spectra and the Fluorescence Spectroscopy. This powerful repertoire of experimental methods is supplemented by computer simulations including quantum mechanic DFT calculations and the methods of molecular dynamics.

The potential benefits arising from the project far exceeds its obvious medical importance. The protein self-assemblies found the application in manufacturing of new nano-materials, tissue engineering or even skin care and cosmetics products. The knowledge of the very basics of the peptides fibrillation could be used as a new tool and help to design new materials with unusual properties.