SUMMARY OF THE PhD THESIS

APPLICATION OF DIFFERENT ANALYTICAL TECHNIQUES TO INVESTIGATING THE OSCILLATING REACTIONS WITH SELECTED PROTEINOGENIC AMINO ACIDS

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In the focus of the summarized PhD thesis are proteinogenic amino acids, which in spite of being the elementary building blocks of all living organisms, have not yet been sufficiently examined in terms of their ability to self-organize, and this characteristic feature was observed with all amino acids investigated within the framework of this study. Spontaneous self-organization of amino acids is observed in the abiotic solutions thereof and it results in the formation of peptides, which in turn can organize to the more complex structures, i.e., to the peptide nano- and microstructures.

In the course of the chromatographic investigations (HPLC-ELSD, HPLC-DAD, and TLC) of the selected monocomponent and binary amino acid systems dissolved in an abiotic environment, their ability was demonstrated to spontaneously undergo chiral inversion and / or peptidization. Identification of the peptidization products was carried out with use of liquid chromatography coupled with mass spectrometry. The microscopic assessment has confirmed that simple peptides formed in the course of self-organization of amino acids can further organize to the nano- and micropeptide structures, and the dependences were established between the molecular structures of the initial amino acids and the shapes of the resulting peptide nanostructures. In order to find an additional confirmation that spontaneous chiral inversion really takes place in the solutions of proteinogenic amino acids, the polarimetric measurements were performed and in purpose to confirm the oscillating nature of the investigated peptidization processes, the turbidimetric measurements were performed as well. Finally, the results of the biuret test have proved the presence of peptides in the examined amino acid solutions. In collaboration with Prof. I.R. Epstein, the theoretical model was elaborated which describes formation of the peptide nano- and microstructures in the binary systems of the proteinogenic amino acids and elucidates the mechanisms playing crucial role in these processes.

The research performed in the framework of this dissertation provides a better insight in the phenomena of the self-organization of amino acids and peptides, which might perhaps influence further progress in the field of molecular biology toward eliminating such factors which accelerate deposition of the morbid amyloid aggregates in living organisms. On the other hand, better understanding of the mechanisms resulting in the formation of the peptide nano- and microstructures can help elaborate novel technologies of their formation without use of a catalysts.