Interactions between calcium carbonate and selected amino acids

Lara Štajner, Jasminka Kontrec, Branka Njegić Džakula, Damir Kralj

Laboratory for Precipitation Processes, Division of Materials Chemistry, Ruđer Bošković Institute, Bijenička c. 54, Zagreb, Croatia

A need for novel and advanced materials, as well as for their environmentally friendly synthesis is constantly growing. Biomaterials and processes of their formation in organisms (biomineralization) are good pattern for production of such materials [1]. Calcium carbonate (CaCO₃), main inorganic component of invertebrate’s hard tissues, is considered to be a relevant biomineralization model. CaCO₃ can precipitate (crystallize), either as a polymorph (calcite, vaterite and aragonite), or hydrated and amorphous phase. The calcite skeletal elements regularly contain small amounts of macromolecules (glycoproteins) which are either, incorporated or adsorbed on the single crystals of calcite. It has been shown previously that the isolated fragments of proteins extracted from mineralised tissue, or their synthetic macromolecular analogues, exert a significant influence on the morphology and crystal structure of calcium carbonate when precipitated in the appropriate model systems [2].

The aim of this research is to investigate a role of the selected amino acids as simple models of macromolecules supposed to be responsible for precipitation of specific calcium carbonate polymorph or different crystal morphology, during the biomineralization processes. Thus, the aspartic acid (Asp), asparagine (Asn) and lysine (Lys) are selected because of different charge of their side chains, while tyrosine (Tyr) and phenylalanine (Phe), as well as serine (Ser) and alanine (Ala), are chosen because of different polarity. The hypothesis is that not only the acidic, but also the hydrogen bonding amino acid can specifically interact with selected CaCO₃ surfaces. Therefore, the Langmuir adsorption constants are calculated from growth kinetic data [3,4] and used as an indication of extent of organic/inorganic interaction.

Acknowledgements: This work is supported by Croatian Science Foundation under the project Bio-Mat-Form (IP-2013-11-5055).

References: