Influence of structurally different amino acids on calcium phosphate precipitation

M. Dutour Sikirić [1*], J. Validžić[2], I. Erceg[3], T. Dražić[1], T. Dražić[1], D.M. Lyons, A. Gajović[1], D. Domazet Jurašin[1], D. Kralj[1]

[1]*Ruđer Bošković Institute, Zagreb, Croatia*
[2]*Faculty of Chemical Engineering and Technology, University of Zagreb, Zagreb*
[3]*Faculty of Science, University of Zagreb, Zagreb*

** sikiric@irb.hr*

Knowledge about the mechanisms of interactions of soluble small organic molecules and/or macromolecules with inorganic crystals is of major importance in understanding the crystallization processes in nature, as well as for the production of materials whenever precise control of crystal size, morphology and texture is required [1]. Among different biogenic crystals, calcium phosphates (CaPs) attract attention due to their role in the normal and pathological mineralization, as well as in industrial processes [1-3]. Recent investigations of influence of additives on CaP formation described in literature are mostly focused on proteins and their synthetic analogous [4]. Although general principles of these interactions are known, the role of specific amino acids is still not clear.

The aim of this research was to investigate the influence of structurally different amino acids on CaP formation and transformation. The selected amino acids differ, either in their charge (Asp, Asn, Lys) or in polarity (Ser, Tyr versus Ala, Phe).

Calcium phosphates precipitation was initiated by mixing the equimolar calcium and phosphate solutions, at strictly controlled hydrodynamic and thermodynamic conditions. The progress of reaction was continuously followed potentiometrically and induction time for nucleation of crystalline phase, i.e. time needed for the commencement of amorphous calcium phosphate (ACP) transformation, was determined. Precipitates were isolated at predetermined intervals during 1 hour and analysed by means of PXRD, FT-IR and SEM.

It was found that in the control system the initial CaP phase that precipitated was ACP which transformed to calcium deficient apatite (CaDHA). Similar mechanism of solid phases formation was observed in the presence of Asn, Lys, Ser, Ala, Phe as well, but the ACP transformation was slightly inhibited, as evidenced by increased induction time. No specific effect on morphology of CaDHA, precipitated in the presence of these amino acids, was observed. However, the formation of CaDHA was progressively inhibited with increasing Asp and Tyr concentration and in these systems DCPD was formed. The obtained results indicated that, in addition to charged, the hydrogen bonding amino acids can be of importance in CaPs formation.

Acknowledgements The financial support of Croatian Science Foundation, Grant HRZZ-5055 is greatly acknowledged.

[1] M.D. Sikirić and H. Füredi-Milhofer, *Adv. Colloid Interface Sci*, 2006, **128-130**, 135.
[2] L. Wang and G.H. Nancollas, *Chem. Rev.* 2008, **108**, 4628.
[3] S.V. Dorozhkin and M. Epple, Angw. Chem. Int. Ed., 2002, **41**, 3130.
[4] K. Bleek and A. Taubert, Acta Biomater., 2013, 9, 6283.