Effect of the Ionic Radius of Monovalent Ions on Octacalcium Phosphate Formation  

Yuki Sugiura* (AIST·HRI), Yasuko Saito (AIST·RISC),  
Takashi Endo (AIST·RISC), Yoji Makita (AIST·HRI)  

Octacalcium phosphate (OCP), a layered calcium phosphate compound, is an attractive material for new medical combination products. OCP is fabricated primarily from soluble calcium salt via an aqueous-mediated hydrolysis process. The co-existing cations are likely to be incorporated into the OCP unit lattice during this process and affect the development of the OCP crystal structure and its thermodynamic stability. However, the key parameters of the co-existing cations, such as the ionic radii and charge number, that affect OCP formation are still unclear. In this study, we focused on the ionic radius of each monovalent ion of alkali metal ions (Li+, Na+, K+, Rb+, and Cs+) for OCP incorporation and formation in a CaHPO₄·2H₂O (DCPD)-(NH₄)₂HPO₄ system with alkali metal salts. There was little incorporation of Li into the OCP unit lattice at low concentrations, whereas Li was incorporated into the OCP unit lattice as a conjugate form of NH₄ and K, which have ionic radii that are larger than Ca, resulting in a HPO₄–OH layered structure in the OCP unit lattice. The Na concentration increased hyperbolically and was incorporated into the OCP unit lattice, resulting in a HPO₄–OH layered structure in the OCP unit lattice. By contrast, Li, K, and Rb resulted in the HPO₄–OH layer in the OCP unit lattice at low concentrations and attenuated OCP formation at high concentrations. Cs only exhibited an attenuation effect on OCP formation. Considering the differences between the Ca ionic radius (1.00 Å) and those of alkali metal ions, the alkali metal ionic radii that were smaller than ~1.5 times the Ca ionic radius could be incorporated into the OCP unit lattice, whereas those greater than ~1.5 times the Ca ionic radius exhibited an inhibiting effect on OCP formation.

Keyword: リン酸カルシウム、骨補填材、バイオマテリアル、バイオミネラリゼーション
*杉浦　悠紀: yuki-sugiura@aist.go.jp