SAPO-39. Zeolites. V. 18. P. 350.
https://doi.org/10.1016/s0144-2449(97)00026-2

Valhmu W.B., Wu L.N.Y., Wuthier R.E. 1990. Effects of ratio, Ca^{2+} × Pi ion product, and pH of incubation fluid on accumulation of $45Ca^{2+}$ by matrix vesicles in vitro. Bone Mineral. V. 8. P. 195.
https://doi.org/10.1016/0169-6009(90)90105-o

Veis A., Dorvee J.R. 2012. Biomineralization mechanisms: A new paradigm for crystal nucleation in organic matrices. Calcified Tissue Internat. V. 93. P. 307.
https://doi.org/10.1007/s00223-012-9678-2

Wang Y.-S., Alrefaei Y., Dai J.-G. 2019. Silico-aluminophosphate and alkali-aluminosilicate geopolymers: A comparative review. Frontiers Materials. V. 6. P. 106.
https://doi.org/10.3389/fmats.2019.00106

Wei S., Wu H., Luo X. 2020. Biomineralization precursor carrier system based on carboxyl-functionalized large pore mesoporous silica nanoparticles. Current Med. Sci. V. 40. P. 155.
https://doi.org/10.1007/s11596-020-2159-3

Wu L.N.Y., Genge B.R., Dunkelberger D.G., LeGeros R.Z., Concannon B., Wuthier R.E. 1997. Physicochemical characterization of the nucleational core of matrix vesicles. J. Biolog. Chem. V. 272. P. 4404.
https://doi.org/10.1074/jbc.272.7.4404

Wu L.N.Y., Genge B.R., Kang M.W., Arsenault A.L., Wuthier R.E. 2002. Changes in phospholipid extractability and composition accompany mineralization of chicken growth plate cartilage matrix vesicles. J. Biol. Chem. V. 277. P. 5126.
https://doi.org/10.1074/jbc.m107899200

Wuthier R.E. 1975. Lipid composition of isolated epiphyseal cartilage cells, membranes and matrix vesicles. Biochim. Biophys. Acta. – Lipids Lipid Metab. V. 409. P. 128.
https://doi.org/10.1016/0005-2760(75)90087-9

Wuthier R.E., Bisaz S., Russell R.G.G., Fleisch H. 1972. Relationship between pyrophosphate, amorphous calcium phosphate and other factors in the sequence of calcification in vivo. Calcified Tissue Res. V. 10. P. 198.
https://doi.org/10.1007/bf02012549

Xu Y., Nudelman F., Eren E.D., Wirix M.J.M., Cantaert B., Nijhuis W.H., Hermida-Merino D., Portale G., Bomans P.H.H., Ottmann Ch., Friedrich H., Bras W., Akiva A., Orgel J.P.R.O., Meldrum F.C., Sommerdijk N. 2020. Intermolecular channels direct crystal orientation in mineralized collagen. Nature Commun. V. 11. P. 1.
https://doi.org/10.1038/s41467-020-18846-2

Morphogenesis of Osteoid Structures during Cultivation of Mesenchemic Stromal Cells on Fibrillary Collagen in the Presence of Silicoalumophosphate

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The effect of glass-crystalline material "Biosit-Sr Elkor" at the early stages of morphogenesis of osteoid structures in cultures of mesenchymal stromal cells of the bone marrow was studied. The maximum cultivation period is 28 days. Morphological studies were performed using scanning electron microscopy. It was found silicoaluminophosphate that accelerates the formation of osteoid structures, enhances the synthesis, compaction and mineralization of fibrillar collagen, activates matrix vesicles by hyperplasia, hypertrophy and excretion. During cultivation, glass-crystalline material partially dissolves and disintegrates, chemical agents with cross-linking, surface-active and mineralizing properties come out into the nutrient medium. The key mechanism for the compaction of collagen fibers is the cross-linking effect of siloxane bonds. Due to the action of surface-active agents, compacted collagen fibers are straightened and perforated with the formation of haversified lamellar structures – structural precursors of bone plates. The mineralizing effect is mediated by an increase in the homo- and heterogeneous nucleation of calcium phosphates, the deposition of mineral nodules in differentiating cells and in the fibers of the collagen substrate, which accelerates the aging of the cell culture. Conclusion: glass-crystalline material "Biosit-Sr Elkor" has a stimulating effect on the early stages of osteogenesis *in vitro*.

Keywords: bone marrow mesenchymal stromal cells, primary cell cultures, type I collagen, silicoaluminophosphates, osteogenesis, matrix vesicles, mineralization, calcium phosphates, bone plates