Rare earth dual-doped multifunctional hydroxyapatite particles for potential application in preventive medicine

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Introduction: Composite biomaterials based on nano hydroxyapatite (HAp) are the subject of numerous studies in reconstructive medicine. Multifunctional and nanoparticulate systems based on HAp and biodegradable polymers are successfully designed as systems for controlled and systemic drug delivery suitable for use in reconstructive medicine [1, 2]. Thanks to the stability and flexibility of the apatite structure, Ca ions can be replaced with various elements (Zn, Sr, Mg, Co, etc.) [3, 4]. Doping the apatite structure enables potential application of this material in preventive medicine, too. Multimodal imaging (MI) is a new and promising technique for improved diagnosis and it is patient-friendly because it saves time. MI has recently attracted much attention due to the advantageous combination of various imaging modalities, such as computer tomography, photoluminescence and magnetic resonance imaging.

Aim: For such a promising approach, we devised new multimodal agents using the doping of a HAp matrix with rare earth (RE) ions.

Materials and methods:

The first stage: a) Ca-nitrate+NH₄OH+H₃PO₄, b) Gd-nitrate, c) Yb-nitrate/Tm-nitrate, d) Eu-nitrate, e) EDTA; I: a), II: a)+b), III: a)+(b)+c)+e), IV: a)+b)+d)+e) at 60°C, 1h with mixing.

The second stage: The hydrothermal reaction, at 200 °C, 12h with mixing.

Results and Discussion:

Conclusion:

Pure HAp (Ca₅(PO₄)₃(OH)), magnetic HAp:Gd (Ca₀.₈₅Gd₀.₁₅(PO₄)₃(OH)), down-converting HAp:Gd,Eu (Ca₀.₉₄Gd₀.₀₃Eu₀.₀₄(PO₄)₃(OH)) and up-converting HAp:Gd,Yb/Tm (Ca₀.₄₅Gd₀.₀₃Yb₀.₁Tm₀.₀₂(PO₄)₃(OH)) were synthesized using a hydrothermal procedure.

References:

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