Contribution ID: **846** Type: **Poster**

LABELLED SUPERPARAMAGNETIC IRON OXIDE NANOPARTICLES

Thursday, 17 May 2018 18:45 (15 minutes)

Superparamagnetic iron oxide nanoparticles (SPIONs) are being studied as contrast agents and drug delivery vehicles in medicine, mainly for easy preparation, low toxicity, biocompatibility and their magnetic properties. SPIONs have become a promising tool in the magnetic resonance imaging, magnetic drug targeting, hyperthermia anti-cancer strategy, and enzyme immobilization. The scope of our work was the synthesis and characterization of SPIONs and their labelling with Tc-99m useful for SPECT diagnostics and also with Ra-223 for targeted alpha particle therapy [1, 2].

SPIONs were prepared by co-precipitation method and then stabilised with 0.1 M sodium citrate, the pH range during the synthesis of iron oxide SPIONs was between 8-14 with maintaining molar ratio of Fe(3+)/Fe(2+) 2:1 under inert condition. The structure and composition of the synthetised nanoparticles were confirmed by FTIR and XRPD. The size of the nanoparticles was determined by dynamic light scattering (DLS). The stability of the nanoparticle dispersion was determined by the measurement of Z-potential.

Labelled SPIONs were synthetised contacting suspension of 1-5 mg SPIONs with commercial generator eluate containing Na^{99m}TcO₄ (200-250 MBq) in physiological saline, respectively ²³³Ra(NO₃ 50-100 kBq in PBS buffer. Stock Ra-223 solution was eluted from generator [1]. Commercial MDP and HDP kits were labelled with 200 –250 MBq Na^{99m}TcO₄and were subsequently contacted with SPIONs in 30 min. Labelled Tc(99m)-phosphonates coordinate on SPIONs surface and their stability was studied. SPIONs labelled with Tc-99m (T1/2 = 6 h) and Ra-223 (T1/2 = 11,43 d) both with excellent yields (> 90%) were also studied for a stability and period of five half-lives in physiological solution, plasma, serum and albumin.

The multimodality of SPIONs has led the biomedicine research in a theranostic research, which is the integration of diagnostic imaging and therapeutic function into a single platform, and has potential for in vivo experiments on physiological mice model.

References:
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This work was supported partially by Health Research Agency of the Czech Republic, grant No.: 16-30544A, CTU in Prague SGS16/251/OHK4/3T/14.

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Session Classification: Poster RPH

Track Classification: Radiopharmaceutical Chemistry, Labelled Compounds