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Evaluation of inorganic ion exchange materials for purification of 225Ac from thorium and radium radioisotopes

Targeted alpha therapy with Actinium-225 (225Ac) or its daughter Bismuth-213 (213Bi) is an emerging and promising treatment for various types of cancers. 225Ac can be produced from a 229Th/225Ra generator system or from proton irradiated 232Th at high or 226Ra at low proton energies. Several types of inorganic ion exchange materials were synthesized to aid in chemical separations. Distribution coefficients (Kd) were determined for 225Ac, Thorium, and other co-produced isotopes metals as a function of the pH of initial solution. Based on the results the column separation was designed. Whenever possible, Ac-225, Th-227 and Ra-223 tracers were used. Otherwise La and Ba were used as surrogate for Ac-225, and Ra-223. The inorganic ion exchanger retained 227Th and 223Ra while 225Ac passed through. Further 227Th and 223Ra were recovered by eluting with different pH solution. In the optimized purification method >90% of 225Ac was recovered with radiopurity >99% (calculated from 225Ac, 227Th and 223Ra). The studies further showed the material could be used for a single column separation of 225Ac from the 229Th/225Ra generator. The capacity of the inorganic ion exchange materials for Barium and 232Th was determined to be 24.19 mg/mL for Barium and 5.05 mg/mL for Thorium. The studies indicate the material could be used to purify 225Ac from a ~300 mg production scale 226Ra target. However, the material would not have the capacity needed for a 50-100 g production scale 232Th target. To supplement these studies the integrity of the ion exchanger in: 1) ammonium acetate at various pH values, and 2) varying HCl and nitric acid conditions was determined.

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