

## Evaluation of inorganic ion exchange materials for purification of <sup>225</sup>Ac from thorium and radium radioisotopes

Targeted alpha therapy with Actinium-225 (<sup>225</sup>Ac) or its daughter Bismuth-213 (<sup>213</sup>Bi) is an emerging and promising treatment for various types of cancers. <sup>225</sup>Ac can be produced from a <sup>229</sup>Th/<sup>225</sup>Ra generator system or from proton irradiated <sup>232</sup>Th at high or <sup>226</sup>Ra at low proton energies. Several types of inorganic ion exchange materials were synthesized to aid in chemical separations. Distribution coefficients (K<sub>d</sub>) were determined for <sup>225</sup>Ac, 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 <sup>227</sup>Th and <sup>223</sup>Ra while <sup>225</sup>Ac passed through. Further <sup>227</sup>Th and <sup>223</sup>Ra were recovered by eluting with different pH solution. In the optimized purification method >90% of <sup>225</sup>Ac was recovered with radiopurity >99% (calculated from <sup>225</sup>Ac, <sup>227</sup>Th and <sup>223</sup>Ra). The studies further showed the material could be used for a single column separation of <sup>225</sup>Ac from the <sup>229</sup>Th/<sup>225</sup>Ra generator. The capacity of the inorganic ion exchange materials for Barium and <sup>232</sup>Th 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 <sup>225</sup>Ac from a ~300 mg production scale <sup>226</sup>Ra target. However, the material would not have the capacity needed for a 50-100 g production scale <sup>232</sup>Th 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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