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155Tb production: a proof-of-concept method for an alternative production of medical isotope

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For several years, many radionuclides (RN) are routinely used in nuclear medicine either for imaging (γ and β^+ or positron) or for therapy (α, β^-, Auger electron emitters). They are most-often administered in the form of a radiopharmaceutical, composed of the selected RN and a targeting unit (nanoparticles or biological vectors, like peptides or antibodies) responsible for the specific accumulation of the drug in the diseased tissues. Numerous efforts are still needed to create a "tool box"and expand the catalogue of clinically relevant RN.
In that context, Terbium is an emerging "theranostic" element, which offers four clinically interesting radioisotopes with complementary physical decay characteristics: ^{149}Tb ($T_{1/2}$ = 4.12 h, α therapy), ^{152}Tb ($T_{1/2}$ = 17.5 h, PET imaging), ^{155}Tb ($T_{1/2}$ = 5.32 d, SPECT imaging and Auger therapy), and ^{161}Tb ($T_{1/2}$ = 6.9 d, β^- and possibly Auger therapy). It is a so-called "theranostic"element (contraction of THERApy and diagNOSTIC), since it enables the development of a unique bioconjugate for radiolabelling prior to administration at both the diagnosis and curative stages. Both radiopharmaceuticals have then strictly identical biodistribution and pharmacokinetic properties,enabling a better adaptation of the targeted treatments, paving the way for more personalized medicine.
The major limitation today for the further use of these RNs is their economically sustainable production in sufficiently large quantities with high chemical and isotopic purities. The ongoing TTRIP project (Tools for Tb RadioIsotope Production for nuclear medicine) * aims to face two challenges related to the ^{155}Tb: to develop an alternative method for producing isotopes that are difficult to obtain using conventional methods, and to develop specific chelators for terbium that are compatible with the use of monoclonal antibodies as biological vectors.
These two aspects of our programme will be detailed, with a more specific focus on the ^{155}Tb production part. First results will be presented.
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