Cyclotron produced 45Ti-Titanium: why & how… so WHY NOT?

P. Costa[1,2] , L.F. Metello[1,3], L. Cunha[1,3], R.R. Jonhson[4] , L.Mattei[4] , W. Gelbart[5] , J. Obermair[6] , B. Dietl[6] , R. Nauschnig[6] , C. Artner[6] , P. Lass[7] , G. Currie[8] , S. Carmo[9] , F.Alves[9] , M. Duarte Naia[2]

1 – Nuclear Medicine Department, ESTSP.IPP, Portugal

2 – CEMUC® - Physics Department, ECT-UTAD, Portugal

3 - IsoPor SA, Portugal

4 – BSCI - Best Cyclotron Systems Inc, Canada

5 – ASD - Advanced Systems Design Inc, Canada

6 – IASON Gmbh, Austria

7 – Medical Faculty, University of Gdansk, Poland

8 – School of Dentistry and Health Sciences, Charles Sturt University, Australia

9 – Institute for Nuclear Sciences Applied to Health, Univ. Coimbra, Portugal

Introduction: There are many different radioisotopes well known and characterized for medical use, with almost all of them able to be artificially produced. Nevertheless, routine clinical applications of PET imaging are still based on 18F, in excess of 97% of the cases, with ^{11}C, ^{13}N and ^{68}Ga sharing the few remaining situations. This trend could change in the – hopingly near – future, since several groups worldwide are busy developing very promising new processes using less conventional radionuclides, aiming to contribute for spreading the use and efficacy of clinical diagnostic using Nuclear Medicine imaging techniques, evolving more and more in the direction of personalized medicine, an worldwide growing societal request. Our group is busy studying ^{45}Ti, interested by its many interesting properties and assuming it as a high-potential candidate: in fact ^{45}Ti presents a physical half-life of 3.09h (50% higher than ^{18}F) together with relevant chemical properties, that enable radiolabelling with bifunctional chelates, ligands or even to radiolabel titanium (di)oxide nanoparticles. Considering that data characterizing excitation functions are mandatory for radionuclide optimal production, the present work refers to our results regarding the $^{45}Sc(p,n)^{45}Ti$ nuclear reaction, being studied as a potential route to efficiently produce ^{45}Ti in low energy cyclotrons.

Materials and Methods: Excitation function of $^{45}Sc(p,n)^{45}Ti$ nuclear reaction was experimentally determined using the stacked foil technique, with 99,5% pure Sc foils mounted on an aluminum target holder and interspaced with 99,999% pure Cu foils, with short irradiations (~1µA proton beam, during 5-10 seconds) using 16 MeV and 18 MeV cyclotrons. In all the cases, results of this activation study were evaluated using HPGe gamma spectroscopy (considering dead time losses always ≤ 5%).

Results: In addition to the excitation function of the main production route, to study the feasibility of efficiently produce ^{45}Ti, some experimental results were also collected with respect to the production of ^{44}Sc or ^{44m}Sc. A short critical analysis about advantages/disadvantages of the use of this unconventional radionuclide will be present as well, briefly mentioning its interesting properties, as well as challenges such as the need for development of specific ligands to be labeled.

Conclusion: We believe on the potential of ^{45}Ti as an interesting positron emitter agent to be used on PET, reason why efforts for the development of its production process are being consented.

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cursomedicinanuclear@gmail.com

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