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Evaluation of HPLC Chromatographic Analytical Method to Determine Radiochemical Purity of [^{177}Lu]-PSMA-I&T

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1. Introduction

In Brazil, prostate cancer (CaP) is the second most common among men (behind only non-melanoma skin cancer). Energy and Nuclear Research Institute (IPEN), the main producer of radiopharmaceuticals in Brazil, is currently studying the labelling conditions of production and stability of a ([^{177}Lu] PSMA I&T) radiopharmaceutical that is used in prostate cancer therapy [1]. PSMA (Prostate Specific Membrane Antigen) radiopharmaceuticals labelled with radionuclides for diagnostic and therapy have been extensively studied from the point of view of radiolabeling and clinical application. Currently, different quality control methods to determine the radiochemical purity (RP) are employed, often focusing on radio-TLC, which has its limitations. When RP is measured by radio-TLC analysis, degradation products caused by radiolysis are frequently not detected. In contrast, HPLC analysis enables the detection of peaks corresponding to degradation products due to radiolysis, being an important assay for evaluating the stability of radiopharmaceutical preparations. This work studied the potential of HPLC-based chromatographic system to evaluate degradation products and radiochemical impurities commonly raised in radiolabeling of PSMA-I&T with ^{177}Lu and stability studies.

2. Methodology

For HPLC analysis of [^{177}Lu] PSMA I&T, 100 µL sample volume, with a 37 MBq/mL radioactive concentration, was injected into the chromatographic system with a C18 reverse phase column (250 mm x 4.6 mm, 5 µm), using as mobile phase: 0.1% TFA (trifluoroacetic acid) in water (solvent A) and 0.1% TFA in acetonitrile (solvent B), using the gradient composed by 0-8 minutes, 76% (solvent A); 8-10 minutes, 60% (solvent A) and 10-18 minutes, 60% (A), using 0.6 mL/minute flow rate at 24°C temperature [2] Analyzes of radiopharmaceutical samples immediately after radiolabeling, free ^{177}Lu and from stability study were carried out in triplicate. The RP was calculated as the ratio of sum of the areas of all peaks in the chromatogram and product peak area, according to Equation 1.

$$\% RP = \frac{product\ peak\ area}{\Sigma\ all\ peak}\ x\ 100 \quad (1)$$

3. Results and Discussion

The chromatogram shown in figure 1, refers to the [^{177}Lu] PSMA I&T, immediately after labeling, showing high radiochemical purity (RP > 99%).

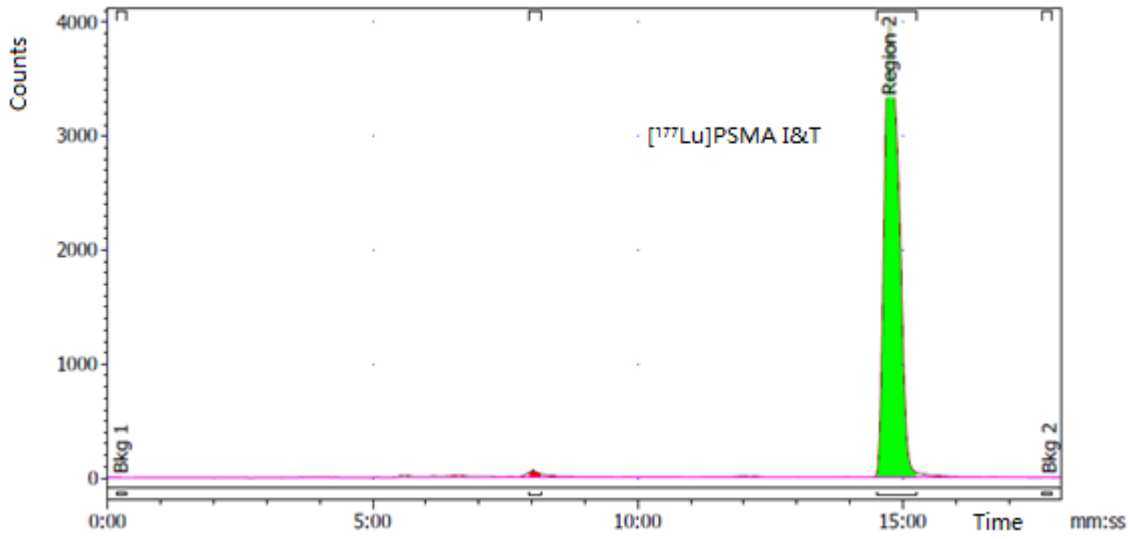

Figure 1. Chromatogram radiolabeled product ([^{177}Lu]-PSMA I&T)

The HPLC system needs studied proved to be effective in evaluating the stability and degradation of the radiopharmaceutical as a function of time.

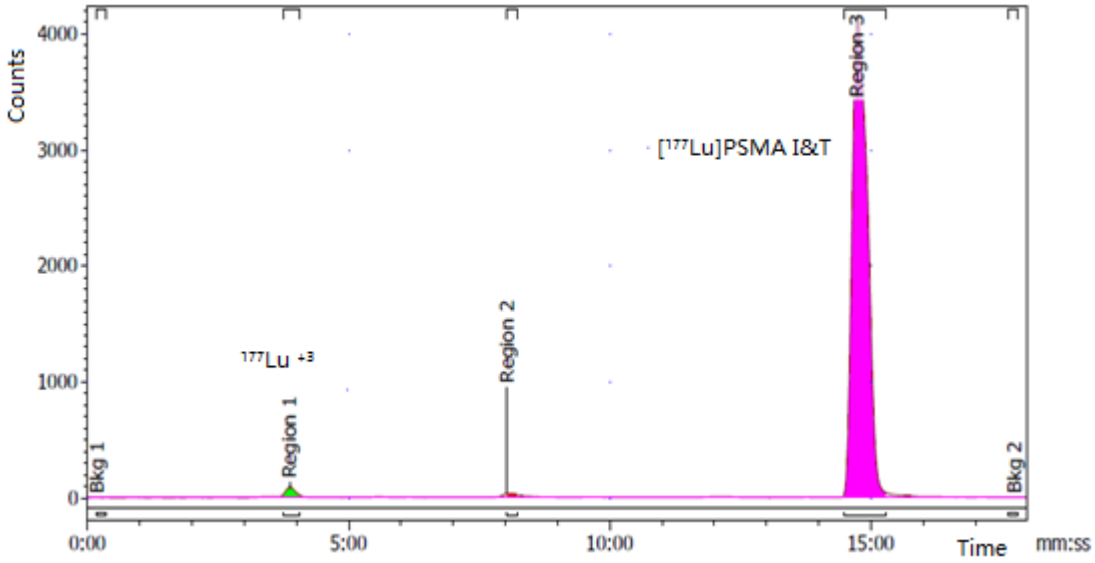

Figure 2. Chromatogram of radiolabeled product [^{177}Lu]-PSMA I&T stored in a -25°C freezer for 48h stability.

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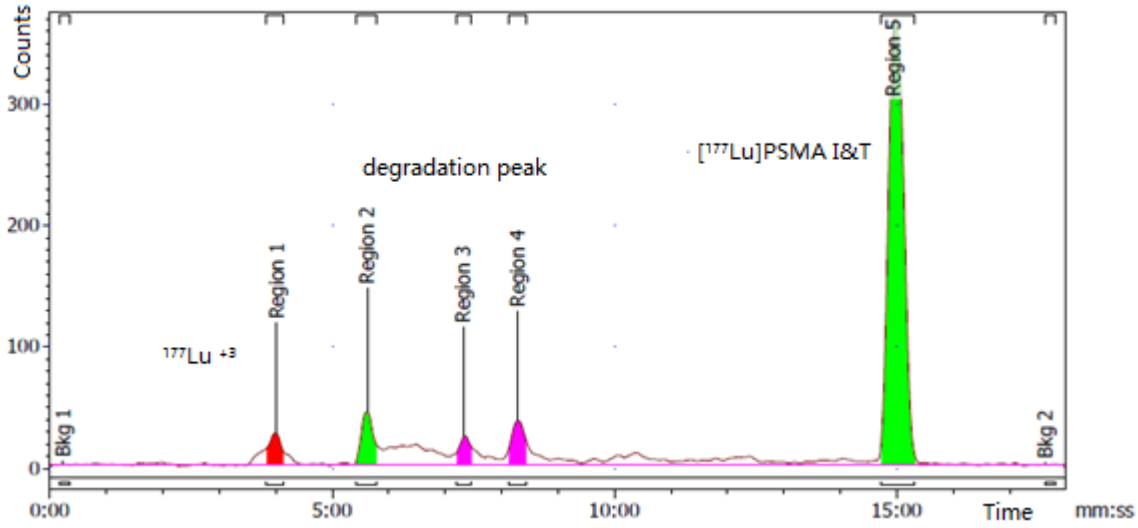

Figure 3. Degradation products chromatogram of radiolabeled product [^{177}Lu] PSMA I&T. Sample stored in a climate chamber (temperature 30°C and relative humidity 35%) for 48h.

4. Conclusions

Therefore, it is concluded that the HPLC proposed methodology was able to separate the radiochemical impurities with high resolution. In addition, system proved to be useful for evaluating the stability of [^{177}Lu] PSMA I&T preparations, and also for quantifying the peaks corresponding to degradation products. The analytical method has the potential to be validated and applied in the radiopharmaceutical quality control routine.

Acknowledgements

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References

[1] “Incidência de Câncer no Brasil”. https://www.gov.br/inca/ptbr/assuntos/cancer/tipos/prostata (2023).

[2] WIECZOREK V. B. C.A. Obtenção de kit de PSMA-617 para pronta marcação com lutécio-177 e sua avaliação na aplicabilidade no tratamento do câncer de próstata, São Paulo -Brazil (2020).