Analysis of contaminating radionuclides in ^{123}I production at IEN

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This report presents a quantitative assessment of the radionuclide contaminants of the ^{123}I produced by the Institute of Nuclear Engineering (IEN) in its radiopharmaceutical division – DIRA. The cyclotron model CV-28 was assembled and installed at IEN in 1974, being at the time the first compact variable energy cyclotron installed in Brazil. Its purpose is to be use in basic research in atomic and nuclear physics, and in the production of radioisotopes for use in nuclear medicine, biology, agriculture and industry, as well as in activation analysis and irradiation damage studies in materials used in reactors. The CV-28 is capable of accelerating four types of particles (*p, d,* $^{3}He^{++}$ and α), which are produced from gases [1]. The work was carried out as part of the stability analysis required by Collegiate board resolution 263/19-ANVISA to ensure radiopharmaceutical preparations that tend to be less stable than their non-radioactive components, with their decomposition by radiolysis, oxidation, reduction and disintegration of the radioisotope therefore, they should be used in the short time [2]. The stability of radiopharmaceuticals depends on many factors, including the energy and nature of the radiation, specific activity and storage time. The effects of primary radiation can induce undesired effects due to the formation of excited nucleus, which can degrade other molecules, for example, those of solvents or preservatives [2]. In order to identify the contaminants generated in the cyclotron – CV 28, during the production of ^{123}I the radionuclide purity is check as part of the quality process. For this step, a hyperpure germanium detector (HPGe) was used, where the characteristic gamma rays were identified of some radionuclides. They are Tellurium – 121, Technetium- 96, Technetium – 95m and 2 peaks of 122 keV, first peak in the Figure 1, which appears to be Cobalt – 57 and 1039 keV.

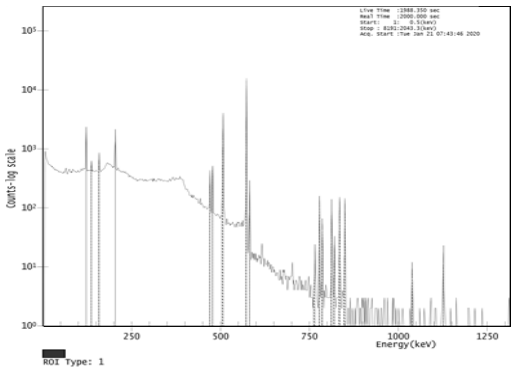

Figure 1. The gamma spectrometry.

It refers to the material irradiated on 03/01/2020 and the analysis of NaI at 6:18 pm of the same day. Figure 1 shows energy peaks characteristics of the contaminates. ^{123}I activity on 09/01/2020 = 17.18 µCi (10.4 mCi at the end of processing). During the analysis of the possible ^{57}Co, it was not possible to identify its characteristic gamma ray, but the origin of this radionuclide may be a reaction, (*p, n*) in iron that is a very common element in any system.
There is still another form of confirmation that leads us to believe that it is cobalt, because 122.06 keV is the main line of ^{57}Co with 85.6% abundance and a half-life of 271 days [3].

Table 1 - Impurity concentrations determined for the end of processing of the ^{123}I activity, from counts performed on 13/01/2020.

Radionuclides	$T_{1/2}$ (h)	Impurity concentrations (%)
Te-121	403.2	0.0395
Tc-96	102.7	0.0036
Tc-95m	1464	0.0011

In order to identify the energy peak of 1039 keV origin, a new irradiation was performed and through the generated data we will determine the half-life following its decay, in order to confirm the generated radioisotope.

References

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